A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

SEPTEMBER, 1939.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

3478. Interaction Between Nuclear Particles. E. C. G. Stueckelberg and J. F. C. Patry. *Helv. Phys. Acta*, 12. 4. *pp.* 300–303, 1939. *In French.*—In the mesotron theory of nuclear forces the interaction between heavy particles is usually worked out by means of a perturbation theory. Actually, however, there are a number of other terms which are of the same order of magnitude as those given by the first-order perturbation theory, and which can be taken into account. Some of them produce a direct interaction between three or more particles. R. P.

3479. Meson Theory of Nuclear Forces. H. A. Bethe. *Phys. Rev.* 55. *pp.* 1261–1263, *June* 15, 1939.—A meson (= mesotron) theory of nuclear forces is developed, in which only one interaction term between the heavy particles and the meson field is assumed. This term is analogous to what would be the field of a point-dipole in electromagnetic theory and accordingly leads to singularities which are removed by arbitrarily cutting-off the interaction at a suitably small distance. Choosing the magnitude of the force and the cutting-off distance so as to obtain the right values for the singlet and triplet state of the deuteron, the right order of magnitude is found for the quadripole moment of the deuteron. In order to obtain the right sign it is necessary to assume that the interaction is transmitted only by neutral mesotrons. R. P.

3480. Passage of Particles through Coulomb Potential Barriers. G. Badarau. *Comptes Rendus*, 209. *pp.* 89–91, *July* 10, 1939.—A mathematical formula obtained by the author [see Abstract 473 (1939)] is given a form which is more suitable for evaluation in the case of a non-vanishing angular momentum. R. P.

3481. Nuclear Five-Body Problem. W. A. Tyrrell, Jr. *Phys. Rev.* 56. *pp.* 250–255, *Aug.* 1, 1939.—Perturbational and variational calculations with single-particle Legendre functions have been made for the nuclear five-body problem of He^5. The symmetric Hamiltonian is employed; the values of the nuclear parameters chosen favour high binding. With a symmetric interaction, Li^5 and He^5 differ only in the Coulomb energy, states of the former lying about 1 eMV above those of the latter. The calculations show that there is no state of He^5 which is stable against dissociation into an α-particle and a neutron. There are two low-lying virtual levels, one of ^{2}P, the other of ^{2}S symmetry; according to the Hartree model, the energies of these states are $-11\cdot7$ and $-6\cdot5$ eMV, respectively. Second-order perturbation calculations diminish the interval $^2\mathrm{S}-{}^2\mathrm{P}$ radically and locate both the states in the neighbourhood of $-19\cdot0$ eMV. The last two results are roughly confirmed by variational calculations with two variation parameters (α-particle model), and -20 eMV may be set as a probable lower bound to the position of either state. These estimated values fall some 7 eMV short of the experimental energy. AUTHOR.

3482. Stability of Isobares Cd-In, In-Sn, Sb-Te and Re-Os. P. Scherrer and E. Zingg. *Helv. Phys. Acta,* 12. 4. *pp.* 283–285, 1939. *In German.*—Mattauch's empirical rule [see Abstract 3 (1938)] on isobaric instability was tested for the isobares (Cd-In), (In-Sn), (Sb-Te) and (Re-Os) with a copper tube counter. The transformation process was detected from the accompanying X-ray emission. F. C. C.

3483. Structure of N^{15}. G. Beck. *J. de Physique et le Radium,* 10. *pp.* 291–293, *June,* 1939.—From a discussion of the possible methods of formation of N^{15} [$N^{15} = N^{14} + n$ or $N^{15} = B^{11} + \alpha$], its nuclear levels are calculated; the distribution of levels is found to be non-uniform. E. E. W.

3484. Concentration of Isotopes by Evaporative Centrifuge Method. J. W. Beams and C. Skarstrom. *Phys. Rev.* 56. *pp.* 266–272, *Aug.* 1, 1939.—The air-driven vacuum-type tubular centrifuge has been used for the concentration of the isotopes of Cl by the " evaporative " centrifuge method. The separations obtained were about the same as predicted by the theory provided the experimental conditions approximately conformed to the assumptions of the theory. With a steel tube 11″ long and 3″ inside diameter, containing baffles to prevent remixing, and spinning at 1060 r.p.s., CCl_4 vapour could be withdrawn from the axis at the rate of 3·2 gm./min. without decreasing the separation factor. This separation factor for Cl, which at any instant is the ratio of the concentrations of the light to heavy isotopes at the axis, divided by the same ratio at the periphery, was 1·025 in the above case. It is believed that the method is practical in the case of the heavier elements. AUTHORS.

3485. Structure and Energies of Hydrocarbon Molecules. J. E. Lennard-Jones and C. A. Coulson. *Faraday Soc., Trans.* 35. *pp.* 811–823, *Aug.,* 1939.—A review is given of theoretical valence rules in molecules, and the structure of many hydrocarbon molecules is correlated with the motions of the valence electrons; these electrons are of two types, those responsible for single or σ-bonds, and those responsible for double or π-bonds. In many cases, such as conjugation of double bonds, these latter electrons must not be considered to be localised in any region, as would be suggested by the usual chemical bond-diagram, but must be considered mobile, free to move throughout the whole molecule. As a result, the energies, lengths, bond orders, resistance to twisting, electric and magnetic properties of these links are profoundly modified, and the nature of these modifications is outlined. Details of the calculation of energy, order and length are given, and tables are included of all those molecules for which results are available. Where comparison with experiment is possible, the lengths and energies agree excellently. Finally a criticism of the method is made, and possible improvements in the calculations discussed. AUTHORS.

3486. Statistical Theory of Association and Polymerisation. J. Frenkel. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 199–207, 1939. *In Russian.*—[See also Abstract 3375 (1939).] D. S.

See also Abstracts 3491, 3501, 3706, 3745, 3766.

COLLOIDS.

3487. Soap Solutions. K. Hess, W. Philippoff and H. Kiessig. *Kolloid. Zeits.* 88. *pp.* 40–51, *July,* 1939.—Measurements of the viscosity, density, refraction index and X-ray determinations of the structures of

V.4
193

solutions of various concentrations of sodium soaps ranging from the formate, (C_1), to the oleate, (C_{18}), lead to the conclusions that in solutions of soaps and similar substances, three states of solution are to be distinguished, *viz.*, (1) a state of molecular solution, (2) a state characterised by the presence of very small micelles or of micelles possessing disordered lattices and (3) a state of crystalline micelles. J. S. G. T.

3488. Relation between Lattices of Natural and Hydrated Cellulose. E. Sauter. *Zeits. f. phys. Chem.* **43.** *Abt.B.* 4. *pp.* 294–308, 1939.—The author continues the discussion on the relation of the structure of cellulose proposed by him to that proposed by Meyer and Mark, and to the earlier one suggested by Spousler and Dore. The various lattice relations are illustrated graphically. Further, the lattice suggested by Spousler and Dore for hydrated cellulose is claimed to be more nearly correct than that of Meyer and Mark. A new explanation is given for the polymorphism between natural and hydrated cellulose. [See Abstract 4791 (1937).] J. I.

3489. Electrophoresis of Collagen. J. Beek, Jr. and A. M. Sookne. *Bureau of Standards, J. of Research,* **23.** *pp.* 271–273, *Aug.,* 1939.—The electrophoretic mobilities of four collagens and a gelatin were measured. One collagen was prepared from a limed steer hide; the other three were from the fresh hide, tendons, and bones of a steer. The differences between the mobilities are explained in terms of differences in the amidonitrogen contents of the various preparations. The isolectric point of the unlimed-hide collagen is at about 7·0 on the pH scale. AUTHORS.

3490. Electrophoretic Studies of Silk. A. M. Sookne and M. Harris. *Bureau of Standards, J. of Research,* **23.** *pp.* 299–308, *Aug.,* 1939.—A microelectrophoretic technique was used to determine the characteristic pH-mobility curves for fibroin and for sericin and to ascertain the extent of removal of the latter during degumming by the soap and enzyme processes. The data suggest that sericin contains a much greater proportion of reactive groups than fibroin and indicate the importance of obtaining either uniform or complete removal of sericin during degumming processes. The isoelectric points are shown to vary slightly with ionic strength. In acetate buffers of 0·02 *M* ionic strength, the isoelectric point of fibroin is 3·6 and that of sericin, 4·3. Large ions of complex structure, such as phthalate or picrate, appear to have specific effects which are readily detectable by the electrophoretic technique. Dissolved fibroin adsorbed on glass particles and fibroin regenerated from similar solutions had the same isoelectric points but different pH-mobility curves. Fibroin regenerated after dissolving in solutions of $LiBr_2$ gave the same pH-mobility curve as untreated fibroin. AUTHORS.

3491. Calculation of Form of Protein Molecules. A. Polson. *Kolloid Zeits.* **88.** *pp.* 51–61, *July,* 1939.—The possibility of determining the forms of colloid particles by observations of the physical properties, *e.g.*, optical and viscous properties of colloidal solutions is briefly discussed. The equations derived by Perrin, Herzog, Kudar and Illig for the diffusion of ellipsoidal particles are employed to determine the lengths and axial ratios of 33 protein molecules and their respective dissociation products. Values of the axial ratio range from 2·86 to 16·6. It is shown that in all cases the lengths of the undissociated molecules and the molecules of the dissociation products are equal. Values of the molecular weight, diffusion constant, specific volume and ratio of the viscosity coefficient of the particles to that of spherical particles of the same weight and volume, are tabulated. The coefficient in Kuhn's equation for the viscosity of sols are modified so that the equation gives the correct viscosity data when the axial ratios (derived from sedimentation and diffusion results) are used in the equation. By means of Kuhn's equation so modified, very good approximate values can be derived of the molecular weights of proteins from data relating to the increase of viscosity at infinite dilution, specific volume and the diffusion constant. J. S. G. T.

3492. X-Ray Investigation of Crystallinity in Rubber. S. D. Gehman and J. E. Field. *J. of Applied Physics*, 10. *pp.* 564–572, *Aug.*, 1939.—X-ray diffraction evidence has shown that a crystalline structure can be produced in rubber by stretching or by freezing. In the former case, a fibre diagram is generally secured, in the latter, Debye-Scherrer rings. When raw rubber was stretched to moderate elongations and frozen an intense fibre diagram was found, showing that the crystallisation proceeded from nuclei set up by the stretching. A series of diffraction patterns illustrating the effect are reproduced. The geometrical conditions of stretching under which " higher orientation " occurs in stretched rubber were studied by photometric measurements of the relative densities of the first two equatorial spots. Graphs are included demonstrating the effect of variations in gauge, width, length and elongation of the specimens. Higher orientation occurs when the percent contraction in gauge exceeds the percent contraction in width. The different physical structures of vulcanised pure gum stocks became apparent in the " higher orientation " characteristics, although the same diffraction pattern was secured. A correlation of the results with current views on the micellar or secondary structure of rubber and the crystallisation of supercooled liquids is attempted. AUTHORS.

3493. Wave-Like Character of Periodic Precipitates. C. V. Raman and K. S. Ramaiah. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 455–466, *June*, 1939.—It is pointed out that the suggestion of an analogy between periodic waves and rhythmic precipitation would be without physical significance unless it can be shown that the characteristic superposition effects observable with waves are also demonstrable with Liesegang patterns. Fourteen photomicrographs and enlargements of Liesegang precipitates of silver chloride and of silver chromate are reproduced with the paper which show that such superposition effects are actually to be observed, both in regard to the intensity of the deposits and in respect of their geometrical configuration. These examples illustrate the varying effects of the superposition of two wave-trains when their wave-length, direction and amplitude are individually or collectively different. It is shown theoretically that when groups of waves interfere, a group-interference pattern exists on a large scale in addition to a wave-interference pattern on a fine scale, the two being separate and distinguishable effects. It is observed that the so-called primary and secondary rings obtained with silver chromate precipitates in gelatin are related to each other as a group is to the individual waves of which it is composed. Independent wave-interferences and group-interferences are exhibited by such precipitates. AUTHORS.

3494. Liesegang Rings. K. S. Ramaiah. *Indian Acad. Sci., Proc.* 9*A*. *pp.* 467–478, *June*, 1939.—Microscopic and microphotometric examinations of Ag_2CrO_4 rings in gelatin have established the existence of a double periodicity in that system. One of these causes the formation of a

V. 19

continuous structure of fine microscopic rings and the other causes a periodic intensification of the precipitate in them. The latter manifests itself to the naked eye as the ordinary rings of Ag_2CrO_4. It has also been shown that the fine rings consist of Ag_2CrO_4 and are not due to the presence of impurities in the gelatin. Differences have been observed between systems in which K_2CrO_4 and $K_2Cr_2O_7$ have been employed in the reaction. The primary rings obtained in the former case are numerous, sharp, closely spaced and highly opaque whereas in the latter they are broad, diffuse and more widely spaced. The distribution of the precipitate in both cases is, in general, symmetrical about the centre in the primary as well as the secondary rings. Measurements of the radii of rings of Ag_2CrO_4 in gelatin and PbI_2 in agar-agar have shown that the laws of Schleussner and Veil are not strictly true over a large range. The variation in spacing is, however, gradual and regular and is probably not a simple function of the radii of the rings. It has been experimentally demonstrated that, under suitable conditions, the precipitation of AgCl and Ag_3PO_4 in gelatin is a periodic and not a continuous process and gives rise to a series of extremely fine rings. As these rings do not show any multiple periodicity they form valuable media for studies on the mechanism of the Liesegang ring formations. Some interesting optical effects exhibited by the rings have also been studied. The closely spaced rings in the silver chromate, chloride and phosphate systems can act as a diffraction grating and give rise to a series of beautiful diffraction spectra. The variation of the grain size of the precipitate in AgCl rings causes the system to exhibit different colours in different regions. Attention is also drawn to the existence of beautiful coloured haloes in many of the systems examined.

AUTHOR.

See also Abstracts 3522, 3525.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

3495. Calculation of Generalised Lattice Potentials. G. Molière. *Zeits. f. Krist.* 101. 5. *pp.* 383–388, 1939.—A mathematical method is developed for the calculation for certain sums which differ from the usual lattice potentials of ionic crystals in that they contain higher powers of the inverse distance between the ions. These sums arise in the calculation of the electrostatic part of the compressibility and the expansion coefficient of ionic crystals. They are evaluated by a generalisation of Ewald's method of calculating lattice potentials. R. P.

3496. Electronic States at Surfaces of Crystals. Part IV. E. T. Goodwin. *Cambridge Phil. Soc., Proc.* 35. *pp.* 474–484, *July*, 1939. —In the present paper application of previous work [see Abstract 1881 (1939)] is made to a specific problem, namely the excitation of an adsorbed atom by the surface electrons of the underlying metal. It is shown that the corresponding mean life-time in a typical excited level is $3\cdot7 \times 10^{-11}$ sec., which is comparable with the value $1\cdot7 \times 10^{-12}$ sec. for deactivation by the conduction electrons when the Brillouin zone is only partly filled. Thus, though this is an essentially surface phenomenon, the effect of the surface electrons is negligible. This suggests that their effect can, in general, only become appreciable in semiconductors or insulators.

AUTHOR.

3497. Calculation of Surface and Twinning Energies of Calcite. F. Kaner. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 218–222,

1939. *In Russian.*—The author discusses the positions of atoms close to the 110 twinning plane in calcite, and assuming a Coulomb law of force calculates the energy needed to split the crystal along the 110 plane as 8200 ergs/cm^2. before, and 4600 ergs/cm^2. after twinning. The energy required to split the crystal along the 100 cleavage plane is found to be 6200 ergs/cm^2. From these results the surface energies of the two planes are deduced (4100 and 3100 ergs/cm^2. respectively), and it is shown that the 110 plane is not a cleavage plane before twinning, but becomes one after. D. S.

3498. X-Ray Study of Ordering Process in β-Phase of Ag-Zn Alloy. S. Shavlo and G. Alaverdov. *J. of Exp. & Theor. Physics, U.S.S.R.* 9. 1. *p.* 59, 1939. *In Russian.*—Although the ordering process in the 50 atomic % Ag-Zn alloy occurs very rapidly, the authors were able to fix the alloy in intermediate states by very violent quenching X-ray studies of these states showed that they are characterised by an " alternating " structure. D. S.

3499. Texture of Zinc Rolled at High Temperature. A. Kolesnikov. *J. of Exp. & Theor. Physics, U.S.S.R.* 9. 1. *pp.* 60–63, 1939. *In Russian.*—The texture of zinc rolled at various temperatures was studied with X-rays. Zinc rolled at 380° C. was found to have a two-fold texture, corresponding to the basal plane parallel and perpendicular to the plane of rolling. This is interpreted as due to slipping along the first-order prism plane and the basal plane respectively. D. S.

3500. Lower Limiting Crystallite Size and Internal Strains in Cold-Worked Metals. W. A. Wood. *Roy. Soc., Proc.* 172*A*. *pp.* 231–241, *Aug.* 3, 1939.—An X-ray examination has been made of the changes in crystalline structure during the progressive cold working of pure Cu, Ag, Ni, Al, Mo and Fe. It is shown that the grains are dispersed into a fundamental unit (crystallite) characterised by a lower limiting size ranging from 10^{-4} cm. for Al to $0{\cdot}7 \times 10^{-5}$ cm. for Cu. This size is deduced from the broadening of appropriate diffraction lines. It is further shown, in the general case of Cu, that on continued cold working the diffraction lines broaden to a maximum and then diminish in width to a definite value, the two processes alternating on further working. At the same time, the lattice dimensions of the crystallites change, having an expanded value when the line is most diffuse and a contracted value when the line breadth decreases. These changes are measured and indicate that the condition of the cold worked metal is marked by two extremes, (*i*) a comparatively stable state with a contracted lattice and minimum line broadening giving the lower limiting crystallite size, and (*ii*) a less stable state characterised by an expanded lattice and an abnormally diffuse line breadth which represents the extent and nature of the distortion transmitted to and retained by the metallic lattice during continued deformation. AUTHOR.

3501. Crystal Structure of HF. P. Günther, K. Holm and H. Strunz. *Zeits. f. phys. Chem.* 43. *Abt.B*. 4. *pp.* 229–239, 1939.—A simple form of Debye-Scherrer camera for use at low temperatures is described, in which the temperatures are measured by means of a thermo-element. The layer of solid HF which was used was between 0·3 and 0·5 mm. thick and the Debye-Scherrer photographs were made at a temperature of 91° K. The evaluation of these photographs did not bear out the expectations of Simons and Hildebrand [see Abstract 388 (1925)] that, because of the anomalous vapour pressure, the molecules are polymerised to $(HF)_6$ molecules probably in rings. The structure found is more in accord with the predictions of Bauer, Beach and Simons [see Abstract 884 (1939)]. The unit cell is tetragonal or pseudo tetragonal with $a = 5 \cdot 45$ Å and $c = 9 \cdot 95$ Å. The cell contains four zigzag chains, each of four HF molecules, arranged parallel to the c-axis. The distance F-H-F is approximately 2·7 Å and the angle FH-FH-FH is about 134°. G. G.

3502. Structure of Tl_2S. J. A. A. Ketelaar and E. W. Gorter. *Zeits. f. Krist.* 101. 5. *pp.* 367–375, 1939.—The Tl_2S was obtained by the melting together of Tl and S in the correct proportions in an atmosphere of H_2, at a pressure of about 60 mm. of Hg and also by the precipitation of an ammoniacal solution of a thallous salt with H_2S. Identical Debye-Scherrer photographs were obtained from these two materials. By means of rotation photographs the identity periods of the hexagonal unit cell were found to be $a = 12 \cdot 20 \pm 0 \cdot 07$ Å and $c = 18 \cdot 17 \pm 0 \cdot 06$ Å giving an axial ratio $c/a = 1 \cdot 490$. The density was determined to be 8·40, thus giving the number of molecules in the unit cell as 27. The Laue symmetry shows the space group to be C_{3i} or C_3 and further consideration of the X-ray data fixes it as C_3^4. The structure is of the C_6 type, but the slight deviations from the ideal structure cannot be exactly determined. Good correspondence between the atomic radii as found and those of Goldschmidt was observed. G. G.

3503. Structure of Hydrated Potassium Chlorostannite. H. Brasseur and A. de Rassenfosse. *Zeits. f. Krist.* 101. 5. *pp.* 389–395, 1939. *In English.*—The structure of the orthorhombic crystal $K_2SnCl_4 \cdot H_2O$ has been determined. The unit-cell has the dimensions $a = 8 \cdot 21$, $b = 12 \cdot 05$, $c = 9 \cdot 10$ Å and contains 4 molecules of hydrated potassium chlorostannite (density 2·582). The space group is $D_{2h}^{16} - Pbnm$ and the atoms and molecules have positions fixed by following coordinates :—

	x	y	z		x	y	z
4Sn	0	0	0	$4K_1$	0·34	0·20	0·25
$8Cl_1$	0·12	0·25	−0·033	$4K_2$	0·40	0·175	0·75
$4Cl_2$	0·21	−0·05	0·25	$4H_2O$	0·50	0	0
$4Cl_3$	0·21	−0·25	0·75				

AUTHORS.

3504. Structure of Thallous-Thallic (or Thallosic) Selenide. J. A. A. Ketelaar, W. H. t'Hart, M. Moerel and D. Polder. *Zeits. f. Krist.* 101. 5. *pp.* 396–405, 1939. *In English*—The crystal structure of TlSe has been investigated. The dimensions of the tetragonal elementary cell are: $a = 8 \cdot 02 \pm 0 \cdot 01$, $c = 7 \cdot 00 \pm 0 \cdot 02$ Å, $c/a = 0 \cdot 873$, $Z = 8$, $d_{r\ddot{o}} = 8 \cdot 31$.

Space group : D_{4h}^{18} $(000, \frac{1}{2}\frac{1}{2}\frac{1}{2}) +$
Thallium : $4(a)$ $00\frac{1}{4}, 00\frac{3}{4}$
$4(b)$ $0\frac{1}{2}\frac{1}{4}, \frac{1}{2}0\frac{1}{4}$
Selenium : $8(h)$ $\bar{x}\frac{1}{2} + x0, \bar{x}\frac{1}{2} - x0, \frac{1}{2} + x\bar{x}0, \frac{1}{2} - xx0.$

with $x = 0 \cdot 179 \pm 0 \cdot 003$. The structure found, indicates that TlSe has to be considered as thallous-thallic or thallosic selenide Tl^{1} $(Tl^{111}Se_2)$, with infinite strings parallel to the c-axis of tetrahedra sharing edges formed by Se atoms round the Tl atoms on $4(b)$. The Tl atoms on $4(a)$ are surrounded by 8 Se atoms. As follows from a discussion of the TlSe distances observed, the TlSe bonds forming the tetrahedra are atomic, whereas the TlSe bonds formed by the thallous atoms $4(a)$ are ionic. A preliminary investigation of the Tl-Se system shows that Tl_2Se and TlSe are the only intermediate phases; no indication of a compound Tl_2Se_3 was found. AUTHORS.

3505. Structure of $SrBr_2$. M. A. Kamermans. *Zeits. f. Krist.* 101. 5. *pp.* 406–411, 1939. *In English.*—Three modifications of $SrBr_2$ exist, the one described in this paper being that resembling $PbBr_2$. The unit cell is rhombic, $a = 9{\cdot}20$, $b = 11{\cdot}42$, $c = 4{\cdot}3$ Å, with 4 molecules in the cell; space group is $Pbnm - D_{2h}^{16}$. The similarity with $PbBr_2$, which crystallises in the same space group and for which $a = 9{\cdot}48$, $b = 8{\cdot}02$, $c = 4{\cdot}71$ Å, is discussed. S. J. G.

3506. Structure of "Crystallised Boron". F. Halla and R. Weil. *Zeits. f. Krist.* 101. 5. *pp.* 435–450, 1939.—The so-called "crystallised B" is shown by analysis to be $Al\,B_{12}$. In the graphitic form of this crystallised B two modifications are present. By means of X-rays their density, crystal form, lattice parameters and space groups have been determined. The first modification is a monoclinic one having $a = 8{\cdot}50$, $b = 10{\cdot}98$, $c = 9{\cdot}40$ Å and $\beta = 110° 54'$ and crystallises in the space group C_s^2 or C_s^3. The second modification is a tetragonal one having $a = 10{\cdot}28$ and $c = 14{\cdot}30$ Å; it can be given a pseudo-cubic setting having $a = 14{\cdot}50$ and $c = 14{\cdot}30$ Å. The space group of this modification is C_4^6, D_4^4 or D_4^8. The structures appear to contain a large number of molecules and a large number of "holes" in the lattice. These facts are considered in relation to the behaviour of black diamonds. G. G.

3507. Space Group of 1,3,5-Trinitrobenzene Crystal. S. L. Chorghade. *Zeits. f. Krist.* 101. 5. *pp.* 376–382, 1939. *In English.*—A determination of the space group of 1,3,5-trinitrobenzene has been made on the basis of rotation and oscillation photographs. The unit cell has the dimensions $a = 12{\cdot}77$, $b = 26{\cdot}97$, $c = 9{\cdot}74$ Å, and contains 16 molecules of $C_6H_3(NO_2)_3$. It is found that the $(0kl)$ reflections are halved if l is odd, the $(h0l)$ reflections if h is odd and the $(hk0)$ reflections if k is odd, and the (hkl) reflections show no characteristic absences. The crystal is, therefore, based on a simple orthorhombic lattice and belongs to the space group Q_h^{15} ($Pcab$) in the holohedral class. AUTHOR.

3508. Structure of Chloranil, $C_6Cl_4O_2$. S. L. Chorghade. *Zeits. f. Krist.* 101. 5. *pp.* 418–424, 1939. *In English.*—Chloranil crystallises in the monoclinic prismatic class. Its unit cell has the dimensions $a = 8{\cdot}77$, $b = 5{\cdot}78$, $c = 17{\cdot}05$ Å, $\beta = 103\tfrac{1}{2}°$, and contains 4 molecules of $C_6Cl_4O_2$. The characteristic extinctions are $(h0l)$ with h odd, and $(0k0)$ with k odd. The space group is thus $P2_1/a(C_{2h}^5)$. An interesting feature of the structure is the pseudo-orthorhombic symmetry with the (201) plane, which is nearly perpendicular to the a axis, as a plane of approximate symmetry. AUTHOR.

3509. Order and Disorder in Pure Liquids and Solutions. J. H. Hildebrand. *Science*, 90. *pp.* 1–8, *July* 7, 1939.—An examination is first made of the degree of order existing in liquids, and in particular with the evidence for orderly arrangement afforded by the change in entropy on vaporisation. Graphs for different liquids are included to show the uniformity of entropy of vaporisation of normal liquids at identical vapour concentrations. Following this comes a consideration of various cases of disorder. An expression is derived to describe the structure of a perfect liquid whereby the problem has been solved of connecting the potential energy between pairs of molecules with the potential energy of a mass of liquid. Solutions are finally dealt with for various types of regularity and complexity. It is concluded that there are but very few perfect liquids, many normal or approximately perfect liquids, still more which are abnormal due to pronounced lack of symmetry either of shape or of electro-

V.
19

static field, and that a number are highly abnormal due to the presence of hydrogen or other chemical bonds. The author finally discusses the structure of water. H. H. Ho.

3510. Growth of Iodine Crystals. M. Pahl. *Zeits. f. phys. Chem.* 184. *Abt.A.* 4. *pp.* 245–267, 1939.—The rate of growth of I_2 crystals over a layer of I_2 at a temperature of 63° C. on to a water-cooled sphere of Cu at a temperature of 15° C. was measured. The growth took place in atmospheres of air, H_2, and Co_2, at pressures between 38 and 760 mm. Hg. The variation of the rate of growth of the (111) or of the $(11\bar{1})$ face with gas pressure was determined for three different distances between the I_2 layer and the cooled surface. The extrapolation of these curves to a value of zero pressure and zero distance gave in all cases the same value of $0{\cdot}82\ 10^{-3}$ cm./sec. for the linear rate of growth of this face. From this an accommodation coefficient for the particular crystal face of $\alpha = 0{\cdot}016$ is calculated. The influence of diffusion and absorption on the course of the curves is discussed. It is also concluded that a polymolecular absorption layer of the gas affects the crystal growth; this effect is more marked in air and in CO_2. G. G.

3511. Twinning of α-Quartz after Transition from β-Form. J. P. Pérez. *Comptes Rendus,* 209. *pp.* 173–175, *July* 17, 1939.—Samples of α-quartz (Brazilian), homogeneous as regards the optic axis, but irregularly twinned were heated for a short time above the α–β transition point (575°), and the changes in twinning examined on cooling. The areas occupied by and the orientation of the two varieties of twins seem to be modified by the mechanical stresses that resulted, but there was also some reference to what these had been before the heating. C. A. S.

***3512. Temperature Gradient Control of Crystallisation from the Melt. D. C. Stockbarger.** *Rev. Sci. Instruments,* 10. *pp.* 205–211, *July,* 1939.—Successful growth of large crystals, *e.g.,* of LiI or KBr, depends on extreme purity of the salt and high temperature gradient across the freezing layer. This latter is effected by an electric furnace accurately controlled by a specially designed instrument of which a detailed description is given. C. A. S.

3513. Formation of Crystallisation Centres in Supercooled Liquids. Part I. V. Danilov, E. Pluzhnik and B. Teverovsky. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 66–71, 1939. *In Russian.* —It was found that supersonic waves increased the speed of formation of crystallisation centres in supercooled piperine; the character of the relation between this speed and the degree of supercooling is also affected by supersonic waves. D. S.

3514. Influence of Surface Phenomena on Number of Crystallisation Centres in a Supercooled Liquid. G. Mikhnevich and J. Brovko. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 215–217, 1939. *In Russian.*—The number of crystallisation centres forming in a thin layer of betol was measured at three temperatures in dependence on the distance from the boundaries of the layer. The results were very rough, but supported the view that the two maxima usually observed in the curve of number of centres against temperature are due to the superposition of two curves due to centres forming near the boundaries and centres forming far from the boundaries, the curve for the former having its maximum displaced to lower temperature. D. S.

3515. Theory of Damping of Vibrations in Crystals. S. Tkachenko. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 314–334, 1939. *In*

Russian.—The author gives a theory of damping of vibrations taking into account the non-linear forces between atoms, and discusses in detail the possibilities of damping both in a continuum and a discrete lattice. The rôle of dispersion in discrete crystals is calculated. The author criticises Peierls' theory of thermal conductivity in crystals [see Abstract 1912 (1930)]. D. S.

3516. Transition Phenomena of Alums at Low Temperatures. R. Guillien. *Comptes Rendus*, 209. *pp.* 21–23, *July* 3, 1939.—$(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$ shows an anomaly in its dielectric constant, ϵ', at $-50°$, *i.e.*, its transition point (λ), similar to that shown by $(NH_4)_2SO_4$. $(NH_4)_2Cu(SO_4)_2 \cdot 6H_2O$ does not. The alums $A''' B' (SO_4)_2 \cdot 24H_2O$ behave differently. With $A = Fe'''$ and $B = NH_4$ ϵ' decreases to about $-100°$, then increases more and more rapidly to $-187 \cdot 5°$, and then very suddenly decreases again. The electrical absorption, ϵ'', and specific heat, c, show maxima at $-187 \cdot 9°$: and $-188 \cdot 4°$, respectively, *i.e.*, at distinctly different points. Hysteresis also occurs. Alums with $A = Cr'''$ and Al, $B = NH_4$ and K behave similarly. C. A. S.

3517. λ-Point Transition of Methane. A. Schallamach. *Roy. Soc., Proc.* 171*A. pp.* 569–578, *July* 7, 1939.—At 20·4° K. a transition, called the λ-point transition occurs in CH_4. Below as well as above this point CH_4 crystallises in a face-centred cubic lattice. Near the λ-point additional or "parasitic lines" are obtained in X-ray pictures. The occurrence of these lines is not uniform; they are found to vary with the experimental, *e.g.*, thermal conditions. These new spacings always retain the same numerical value and thus they must belong to structures which exist only near the λ-point. The λ-point is, therefore, a much more complicated phenomenon than the commonly accepted explanation would lead one to suppose. This explanation relates the anomalous rise in specific heat to a rapid increase in rotation of the molecules in the crystal lattice, which is itself assumed to retain its face-centred cubic structure. There is no direct evidence of this rotation. G. G.

See also Abstracts 3487, 3523, 3588, 3699, 3702, 3759, 3760, 3808, 3810.

DENSITY.

3518. Density and Compressibility of Solid Hydrogen and Deuterium at 4·2° K. H. D. Megaw. *Phil. Mag.* 28. *pp.* 129–147, *Aug.*, 1939.—Direct experimental determinations have been made of the density of solid H_2 and D_2 at 4·2°K. and pressures up to 100 atm., and the compressibilities have been calculated. These results have been used to discuss the relations between the specific heats at constant pressure and constant volume and the expansion coefficients from the standpoint of Grüneisen's law and the Debye theory. It is shown that the usual treatment fails to give consistent results, the failure being attributed to the large part played by zero-point energy, which is not taken into consideration in the ordinary theory. AUTHOR.

See also Abstract 3487.

DIFFUSION AND OSMOSIS.

3519. Mutual Diffusion of Metals through an Intermetallic Compound. J. Frenkel and M. Sergeev. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 189–198, 1939. *In Russian.*—The mutual diffusion of metals through the layer of intermetallic compound is discussed and the change of thickness of this layer with time is calculated. The results are found to agree with the available experimental data. D. S.

3520. Gas Flow in Solids. R. M. Barrer. *Phil. Mag.* 28. *pp.* 148–162, *Aug.*, 1939.—Solutions of the diffusion equation $\partial c/\partial t = D\partial^2 c/\partial x^2$ are known for (1) The concentration as a function of distance and time; (2) the quantity of gas adsorbed or desorbed at a given time; (3) the permeability in the steady state; (4) the permeability in the non-stationary state of flow, and (5) the intercept which the curve pressure against time (*i.e.*, the permeability curve in the non-stationary state) makes on the axis of time. These quantities all afford methods of measuring D. The present paper investigates the problem of gas flow by diffusion in combination with phase boundary processes corresponding to transfer from a gas phase or an adsorbed layer into the solid, and transfer from the solid into an adsorbed layer or into a gas phase. Solutions corresponding to each case (1) to (5) have been obtained, and are given for the general as well as for special cases. The results show that there can be an unexpectedly large influence of these surface processes upon properties such as permeability, and a very big concentration discontinuity at the surfaces. Sufficient different types of equation are given for the evaluation of all three of the velocity constants involved. AUTHOR.

3521. Diffusion of Aggregating Electrolyte in Transition Range from Simple to Colloidal Solution. G. S. Hartley. *Faraday Soc., Trans.* 35. *pp.* 1109–1113, *Aug.*, 1939.—It is shown how the aggregation of ions in an electrolyte to produce micelles which are mobile in the electric field, may cause a fall of the diffusion coefficient followed by a rise. Experimental observation of this has recently been reported. [See Abstract 1476 (1939).] AUTHOR.

ELASTICITY AND PLASTICITY.

3522. Equilibrium of Thin Compressible Membrane. G. E. Hay. *Canad. J. of Research*, 17. *Sect. A. pp.* 106–121, *June*, 1939.—An investigation has been made of the equilibrium of a thin incompressible elastic membrane lying between two rigid bodies, one fixed and the other mobile. The present paper concerns the corresponding problem for a compressible membrane. Membranes are divided mathematically into four classes according as their compressibility is (*i*) finite, (*ii*) small, (*iii*) very small, (*iv*) so small that the membrane may be considered as incompressible. The movable boundary is assigned a rigid body displacement. By the introduction of approximation based on the thinness of the membrane a determination of the resulting stress, strain and displacement is made for each of the above four classes of membranes. [See Abstract 1415 (1938).] AUTHOR.

3523. Age-Hardening in Pure Al-Ag Alloys. L. Guillet and L. Guillet, Jr. *Comptes Rendus*, 209. *pp.* 79–81, *July* 10, 1939.—High purity alloys were produced in an electric furnace in graphite pots, cast into 3 cm. round chills, annealed 100 hr. at 500° and cooled very slowly; after this treatment the 10% and 20% Ag alloy were malleable and could be rolled and drawn down to 5 mm. without intermediate reheating. After heating for 1 hr. at 550 °C. and water quenching, the alloys were annealed at increasing temperatures for ½ to 4 hr. and the hardness measured subsequently. In the 10·83% Ag alloy, maximum hardness of 51 is attained in 3 hr. at 70° C., 49 in 1½ hr. at 120° C. and at 150° C. a peak of 50 is reached in 45 min., the hardness then diminishes rapidly. For alloys higher in Ag analogous curves are obtained but they are displaced towards the origin and peaks occur at lower annealing temperatures. Microexamination shows no new constituent until long after the hardness peak, when it appears along the solid solution cleavage planes. X-ray examination by the powder method with Cu$K\alpha$ radiation and Ni filter ($\lambda = 1{\cdot}54$ Å) does not show the γ phase of Hansen containing 85·7% Ag, but an intermediate phase analogous to that in Al-Mag and in Al-Cu. As age-hardening progresses a diminution in lattice parameter, indicating a reduction in Ag content, occurs. Lines attributable to γ are, however, observed after annealing at 550° C. D. R. H.

3524. Mechanical Properties of Age-Hardening Al-Mg-Zn Alloys. J. Hérenguel and G. Chaudron. *Comptes Rendus*, 209. *pp.* 109–111, *July* 10, 1939.—The authors report in the form of quaternary diagrams, for alloys containing up to 8% Zn + 9% Mg, ultimate stress after quenching, and ultimate stress and elongation after standing at room-temperature. It appears that alloys containing about 6% Mg+3% Zn are relatively soft on quenching but attain mechanical properties even better than those of known light alloys on standing, *viz.*, 50 kg./mm.^{2} (32 tons /in.^{2}) while retaining an elongation of over 20%. A rise in temperate causes marked acceleration of ageing, at 100° C. it is possible to obtain an ultimate stress of 56 kg./mm.^{2} (35·5 tons/in.^{2}) and elastic limit of 45 kg./mm.^{2} (28.5 tons/in.^{2}). When made up from pure materials the alloys show corrosion resistance equal to that of Al-Mg alloys. After ageing they have high fatigue strength. D. R. H.

3525. Particle Size and Plasticity of Lime. D. L. Bishop. *Bureau of Standards, J. of Research*, 23. *pp.* 285–292, *Aug.*, 1939.—Particle-size distributions and Emley plasticity values were determined on 25 hydrated limes. The geometric weight-mean diameter varied from 2·9 to 7·8 μ. There was no relation between their particle-size distributions down to 2 μ and their Emley plasticity values. Hydrated limes having very similar particle-size distributions had widely different plasticities. Particle-size measurements down to about 1 μ were made on quicklime putties prepared by hydrating quicklimes with an excess of water. Putties prepared in such a manner were very much finer than the commercial hydrated limes. There was also no relation between the distributions down to 1 μ and the Emley plasticity values of the quicklime putties. Limes having the same calculated specific surface may have widely different particle-size distributions. It is possible that the size distribution of the material finer than 2 μ may be the determining factor in the plasticity of limes. AUTHOR.

See also Abstracts 3500, 3721.

HYDRODYNAMICS AND AERODYNAMICS.

3526. Two-Dimensional Hydrodynamical Theory of Moving Aerofoils. Part III. R. M. Morris. *Roy. Soc., Proc.* 172*A. pp.* 213–230, *Aug.* 3, 1939.—This paper follows two previous ones [see Abstract 952 (1938)] on the general hydrodynamical problem of the two-dimensional motion of a cylinder in inviscid incompressible fluid. The general formulæ obtained in these papers are here reduced for the special case of the Joukowski aerofoil, where the coefficients assume simple finite forms. The formulæ obtained are then applied to a determination of the lift, moment and centre of pressure in uniform rectilinear motion, and also to a discussion of the dynamics of the small oscillation about such rectilinear motion. A simple condition is then obtained for the stability of this rectilinear motion, showing the effects of thickness, camber and angle of attack on this important property of the aerofoil. AUTHOR.

3527. Decrease of Resistance to Motion at Supersonic Velocities by Chilowsky's Method. D. Riabouchinsky. *Comptes Rendus*, 208. *pp*. 2037–2040, *June* 26, 1939.—Chilowsky, in 1915, suggested the possibility of reducing the resistance to a projectile moving in air by changing, *e.g.*, the temperature, density or composition of the air, and proposed to achieve this by projecting combustible products in advance of the projectile. The efficacy of the procedure has been confirmed by Huguenard. (*La Technique aéronautique*, 1924, *No*. 38. *pp*. 384–386.) The author develops a theory which gives quantitative precision to the variation of resistance to be anticipated by the application of the so-called method of flames. A reduction of resistance of the order 80% would appear to be possible by the combustion of a mixture of red P and CuO in advance of a projectile. J. S. G. T.

3528. Application of Principle of Limit Law to Dimensional Analysis. R. Esnault-Pelterie. *Comptes Rendus*, 209. *pp*. 190–194, *July* 24, 1939.—The laws of flow of an incompressible fluid through a valve of area s being supposed to be $s = \Delta p^n/k$ and $\Delta p = \mathrm{A}\rho \mathrm{D}^2/s^2$, where Δp is the drop of pressure, ρ the density and D the discharge, the dimensions of ρ, D, k, Δp, viscosity, mass of the valve per unit surface are derived. A complicated expression involving the various dimensional formulæ is derived for Δp and the author's limit-law is expressed in the form $\Delta p = \mathrm{A}^{1+2n} \sim \rho \mathrm{D}^2 k^2$. The expression for Δp is discussed [see Abstracts 3330 (1933) and 76 (1937)]. J. S. G. T.

3529. Experimental Phenomenon Observed with Vortex Rings Set in Translatory Motion in Actual Fluids. C. H. Krutzsch. *Ann. d. Physik*, 35. 6. *pp*. 497–523, *July*, 1939.—A method of producing and colouring vortex rings, principally formed in water, so that the generation and structure of the rings can be investigated photographically is described. The observations made establish the occurrence of flexure of the rings and regions of instability shown by the rings. A theory of the phenomena is developed. J. S. G. T.

3530. Stationary Contingent Functions and the Statistical Theory of Homogeneous Turbulence. J. K. de Fériet. *Ann. Soc. Sci. de Bruxelles*, 59. *pp*. 145–194, *July* 12, 1939.—The history of the statistical theory of homogeneous turbulence, first discussed by Taylor is briefly outlined; the principal results obtained by Slutsky, Khintchine and Kolmogoroff in their development of the theory of stationary contingent functions, which form the basis of the present work are given, without proof; three problems in homogeneous turbulent motion, including the problem of Brownian motion, discussed by Taylor, are treated by the method of stationary contingent functions; relations between the coefficient of correlation and the spectral functions (terms occurring in Taylor's theory), are discussed. In particular it is stressed that it is spectral bands, rather than spectral rays that give to the spectrum of turbulence its characteristic features. J. S. G. T.

3531. Turbulent Liquid Motion outside a Circular Boundary. M. Ray. *Phil. Mag*. 28. *pp*. 231–240, *Aug*., 1939.—An approximate solution of Goldstein's modified equations of Taylor's general theory of turbulence is derived, in a form applicable near a circular boundary, by the method of successive approximation, which ultimately gives the velocity profile in the turbulent layer near the boundary, although the approximation may not suffice for the transition layer between turbulence and stream-line motion. The analysis ignores the viscous layer near the boundary. The velocity profile curve shows how the retrograde velocity in the turbulent layer gradually changes into a direct velocity, after which stream-line motion is established. J. S. G. T.

3532. Outlook in Fluid Mechanics. W. F. Durand. *Frank. Inst., J.* 228. *pp.* 183–212, *Aug.*, 1939.—This paper contains a popular description of the part which fluid mechanics plays, not only in daily life, but throughout the entire domain of nature. It first deals with the peculiar relation between a fluid and a solid body moving through it, and therefore involves a discussion of viscosity and compressibility. This leads to a very comprehensive description of laminar and of turbulent flow, in which the author opines that the most promising present line of advance in the study of the immediate phenomena of turbulence, lies in the direction of the statistical approach, involving the development of a series of velocity correlation functions as a measure of the " structure " of turbulence. The transition from laminar to turbulent flow is then very fully considered, reference being made to ionisation in relation to movement of air, and leads to a prolonged discussion of the nature of physical forces between adjacent molecules in a fluid both for liquids and gases. The paper ends with a survey of the subject of compressibility and of shock waves in gases. As a qualitative presentation of a difficult though superlatively important subject the paper is highly to be commended.

H. H. Ho.

See also Abstracts 3533, 3699.

KINETIC THEORY OF MATTER.

See Abstracts 3515, 3678.

LENGTH, AREA AND VOLUME.

See Abstract 3667.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

3533. Integration of Boussinesq's Equation of Natural Convection. P. Vernotte. *Comptes Rendus*, 209. *pp.* 19–21, *July* 3, 1939.—The possibility of integrating Boussinesq's equation of free convection relating to convection from a thin vertical plane of infinite extent in the horizontal direction in a perfect fluid of low conductivity is discussed along the lines developed in a previous note by the author [see Abstract 3137 (1939)]. It is shown that a complete solution can be derived for the case of an infinite semi-plane, and an approximate solution for the case in which the plane does not extend to infinity in the vertical direction. J. S. G. T.

3534. Generalisation of Polynomial $F_n(x)$. S. Pasternack. *Phil. Mag.* 28. *pp.* 209–226, *Aug.*, 1939.

3535. Approximation to a Function of One Variable from a Set of its Mean Values. M. Greenspan. *Bureau of Standards, J. of Research*, 23. *pp.* 309–317, *Aug.*, 1939.—Physical data intended to represent the variation of a function of a single variable may be actually mean values of the function over intervals of the argument. Formulæ for approximating to the values of the function from such data and examples of their use are presented in this paper. These formulæ have been applied to problems of strain distribution in the Engineering Mechanics Section of the National Bureau of Standards. AUTHOR.

*3536. **Increase of Sensitiveness of Apparatus for Measuring Reaction. E. Perucca.** *Accad. Sci. Torino, Atti,* 74. *Disp.* 3a. *pp.* 234–243, *Jan.–March,* 1939.—Having defined the concept of reaction as applied to measuring apparatus, in particular to the galvanometer, a discussion is given of the advantage provided by an increase of the sensitiveness of the apparatus thanks to the employment of reaction. This advantage is in the main the subject of the cases discussed. A reaction to gravity shows itself to be the most convenient: it is already made use of in the loop galvanometer of Mechau-Zeiss. Two pieces of apparatus with gravitational reaction are discussed. But it is only in particular cases that the employment of this reaction which can be regulated, with the inevitable complications of construction, can be considered as justified. J. J. S.

3537. Parabolic Equalisation of Unequally Accurate Observations. A. Tarkhov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 96–105, 1939. *In Russian.*—The author discusses the application of the law of least squares to the determination of the coefficients in a parabolic relation from observations in which the parabolic function is subject to random errors which increase proportionally with the value of the function. In this case the usual methods give undue wieght to the large values, and the author deduces special formulæ which he shows by numerical examples lead to a better interpolation of the observations. D. S.

3538. Law of Error and Combination of Observations. H. R. Hulme and L. S. T. Symms. *Roy. Astron. Soc., M.N.* 99. *pp.* 642–649, *June,* 1939.—The normal law of errors is not well founded, either experimentally or theoretically, and does not offer any really satisfactory criterion for the rejection of large observations. Following Newcomb and Jeffreys [see Abstract 3087 (1938)], a method is developed which allows a system of continuous weighting to be found for a series of observations at Greenwich with a small but definite improvement of the results. AUTHORS.

3539. National Standards of Measurement. L. J. Briggs. *Rev. Modern Physics,* 11. *pp.* 111–120, *April,* 1939.—Account of the National Standards of Measurement in U.S.A. together with a brief historical résumé. Standards are discussed in the following order:—(1) length, (2) surface planarity, (3) angular measure, (4) mass, (5) cubical capacity, (6) frequency, (7) electrical resistance, (8) E.M.F., (9) self inductance, (10) mutual inductance, (11) current, (12) temperature, (13) the roentgen, (14) radium standard, (15) radiant flux, (16) standard of brightness. F. C. C.

3540. Recent Comparisons of Electrical Units of Various Countries. A. Pérard, M. Romanowski and M. Roux. *Comptes Rendus,* 209. *pp.* 23–25, *July* 3, 1939.—In connection with the work of the International Weights and Measures Committee, in preparation for the change from international to absolute electrical units, the authors have compared the electrical standards of various national laboratories, to determine as accurately as possible the differences between the existing realisations of the international units. For the comparison of standard ohms, Pérard and Romanowski used a Thomson double bridge modified to eliminate the resistances of the potential tappings of the standard ohms. As judged by the reduction in residual errors, the accuracy of measurement has been improved substantially during recent years [see Abstract 4304 (1934)]. For the comparison of Weston cells, Romanowski and Roux used a potentiometer specially adapted to the measurement of small differences of e.m.f. Tables in the original paper show the successive values of the American, British, French, German, Japanese and Russian national standards of resistance and e.m.f. during the period 1933–1939. R. E. N.

***3541. Harmonic Analyser (Harvey System).** *Zeits. f. Instrumentenk.* 59. *pp.* 288–293, *July,* 1939.—A harmonic analyser, based upon a partly new mathematical principle, capable of giving up to the sixth term of the harmonic series, and which can be used as a planimeter and as an integrator for determining moments of inertia, is described. Essentially the instrument comprises a straight rod (PW) of which the end P is constrained to follow the curve to be analysed and the axes and which is maintained at an inclination nx to the y axis at each point (coordinate x) of the curve. A recording roller is attached at W with its axis along PW. Additional gearing and wheels enable the analyser to be used for the determination of 8, 10, 12 and 14, or 7, 9, 11 and 13 terms of the harmonic series. J. S. G. T.

See also Abstracts 3528, 3530, 3600, 3780, and

1806B. Systems of Electrical Units. M. Dick.
1807B. Number of Independent Units in Theory of Electromagnetic Phenomena. J. Fischer.

MECHANICS, CLASSICAL.

3542. Regular Precessions of a Weighted Gyroscope with Armature. M. Pascal. *Accad. Lincei, Atti,* 29. *pp.* 185–190, *March* 4, 1939.—A mathematical treatment is given of this problem and a notable particular case is dealt with briefly. J. J. S.

MECHANICS, QUANTUM.

3543. Wave Functions of a Coulomb Field. P. Pavinsky. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 4. *pp.* 411–425, 1939. *In Russian.*—Formulæ are deduced for series expansions in logarithmic terms of the wave functions of a Coulomb field, having asymptotically the form of diverging spherical waves. The recurrence formulæ connecting the solutions for various azimuthal quantum numbers are also found. The results are applied to obtain numerical values of the wave functions of a Coulomb field near the origin. Tables of numerical values are drawn up by the author and **A. Krichagina** (*ibid. pp.* 419–425). D. S.

3544. Wave Equations for Particles. G. Pétiau. *Comptes Rendus,* 208. *pp.* 1709–1711, *May* 30, 1939.—A wave equation for a particle of integral spin (in units of $h/2\pi$) is obtained. R. P.

3545. Wave Equation of a Corpuscle with Two Mass-States, Capable of Representing the Proton-Neutron. G. Pétiau. *Comptes Rendus,* 209. *pp.* 194–197, *July* 24, 1939.—A system of wave equations of a corpuscle characterised by two mass-states (not zero), and capable of representing, *e.g.*, the double corpuscle proton-neutron is developed. J. S. G. T.

3546. Wave Functions of Relativistic Hydrogenic Atom. L. Davis, Jr. *Phys. Rev.* 56. *pp.* 186–187, *July* 15, 1939.—The radial functions for the discrete levels of Dirac's relativistic hydrogenic atom are expressed in terms of the generalised Laguerre polynomials which have known properties. This leads to an easy method of evaluating the normalisation constants and the average values of r^q. AUTHOR.

3547. New Notation for Quantum Mechanics. P. A. M. Dirac. *Cambridge Phil. Soc., Proc.* 35. *pp.* 416–418, *July,* 1939.—The new notation has as its chief aim the invention of a symbolism in which the abstract Hilbertian vectors and linear operators have the same symbols as their representatives. G. C. McV.

3548. Quantum Electrodynamics. Parts I and II. F. Hoyle. *Cambridge Phil. Soc., Proc.* 35. *pp.* 419–462, *July,* 1939.—The usual theory of quantum electrodynamics is outlined and an alternative method of quantisation is introduced. Some of the difficulties of this theory are discussed and a modification is introduced to meet them. The theory is developed so as to satisfy the principle of relativity, but is not quantised. It is shown that two separate forms of theory can be developed in which a "finite size" is attributed to a charged particle by means of its interaction with the radiation field. The region attributed in this way to the particle is four-dimensional and is determined in such a manner that the usual difficulties with relativistic invariance do not arise. The advantage of such a theory becomes clear when the theory is applied to those problems in which the usual calculations give infinite results. The problem of the method of successive approximations is considered and satisfactory results are obtained provided that the space dimensions of the finite region are of the order of the classical radius of the electron, when the electron is at rest. It may be noted explicitly that the difficulty that has been associated with the emission of low energy quanta by "Bremsstrahlung" will not arise in the present formulation of the electromagnetic interaction between field and particles. This case is interesting since an infinity arises here which is not analogous to the self energy infinities, but occurs in the direct calculation of a physical process and not in a virtual transition. The theory seems satisfactory so far as low energy processes ($< 137mc^2$) are concerned and the real test of its applicability may be expected to arise in discussing processes of high energy. It is hoped to treat these in a later paper. AUTHOR.

3549. Hamilton's Canonical Equations for Motion of Wave Groups. A. D. Fokker. *Physica,* 6. *pp.* 785–790, *Aug.,* 1939. *In English.*—Following up a suggestion by H. A. Lorentz, the author realised several years ago that starting from the differential wave equation, Hamilton's canonical equations for the motion of a wave group may be deduced. The argument is here reproduced in a more elaborate form.
AUTHOR.

3550. Particle Statistics. J. Géhéniau. *Comptes Rendus,* 209. *pp.* 87–89, *July* 10, 1939.—If a particle is made up of *n* electrons (positive or negative) it is possible to prove that it must obey Dirac-Fermi or Bose-Einstein statistics according to whether *n* is odd or even. R. P.

See also Abstracts 3478, 3481, 3496, 3688, 3701, 3709, 3762, 3780.

PRESSURE.

See Abstract 3586.

RELATIVITY AND ETHER.

3551. Motion of Finite Masses in General Relativity Theory. V. Fock. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 4. *pp.* 375–410,

1939. *In Russian.*—The author discusses Einstein's equations for the gravitational field and the equations of motion when the radii of the bodies are large compared with their gravitational radii. Solutions are given to a second approximation in the ratio of these radii. Applications to the solar system are given. D. S.

3552. Astronomical Consequences of Relativistic Two-Body Problem. S. Sulaiman. *Phil. Mag.* 28. *pp.* 227–230, *Aug.*, 1939.—Levi-Civita's result that, in the two-body problem of general relativity, the centre of the mass of the two bodies undergoes an absolute acceleration is shown to be erroneous. G. C. McV.

3553. Trajectories of Dipolar Particles in Non-Holonomic Unified Field Theory. Y. Mutô. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 263–269, *June*, 1939. *In English.*—The variational principle is applied to deduce a set of equations which are tentatively proposed as the trajectories of dipolar particles in the non-holonomic unified field theory [see Abstract 479 (1938)]. When the field of the equations is what appears in the ordinary unified field theories the equations express the trajectories of electric particles; when it is the dual of the latter, the equations express the trajectories of magnetic particles. J. S. G. T.

See also Abstracts (3695) and

1800B. Representation of Physical Space and Laws of Dynamics. J. Loiseau.

SOLUTION.

See Abstract 3509.

SURFACE PROPERTIES.

3554. Adsorption at Interfaces. M. Aubry. *Comptes Rendus*, 208. *pp.* 2062–2064, *June* 26, 1939.—Determination of the variations with time of the interfacial tension at an oil-water interface is unsatisfactory if the oil used is paraffin oil on account of the uncertainty of its composition. Better results are obtained if the oil is replaced by CCl_4. Thus when a little oleic acid is added to the CCl_4 a steady state is reached in a few hours as compared with over 24 if paraffin oil is the solvent used for the oleic acid. C. A. S.

3555. Damping of Capillary Waves. A. Klemm. *Phys. Zeits.* 40. *pp.* 483–486, *July* 15, 1939.—In a previous paper dealing with the theory of the kataphoresis of gas bubbles, the author has pointed out that liquid surfaces, even in the case of liquids of great purity, are characterised by the occurrence of a very highly viscous skin [see Abstract 23 (1939)]. The effect of this skin in damping-out capillary waves is discussed theoretically, the assumption being made that the dynamical surface tension of a liquid comprises two parts: *viz.*, (1) that due to the high viscosity of the capillary layer, and (2) that associated with the relaxation time of the surface tension. The cases of long and short waves, both stationary and progressive, are discussed. J. S. G. T.

3556. Surface Tension and Angle of Contact of Mercury in Vacuo. A. E. Bate. *Phil. Mag.* 28. *pp.* 252–255, *Aug.*, 1939.—Clean dry Hg, which partly filled an evacuated and sealed tube, was found to have an angle of contact of 90° with the side of the tube, and a surface-tension of 490 dynes per cm. The method of obtaining this value is described. AUTHOR.

3557. Influence of Carbohydrates upon Interfacial Tension between Water and Cyclohexane. J. B. Matthews. *Faraday Soc., Trans.* 35. *pp.* 1113–1122, *Aug.*, 1939.—Interfacial tension measurements have been made on aqueous solutions of various carbohydrate substances against cyclohexane. In all cases (except those of starch and inulin) equilibrium values are recorded, *i.e.*, the ageing process, which is of the order of minutes, has been completed. The shape of the capillary curve obtained when the lowering of the interfacial tension is plotted against the concentration is shown to depend on the type of monomolecular surface film existing at the interface, which in turn depends on the shape of the carbohydrate molecules constituting this film. The existence of gaseous, condensed, and heterogeneous adsorption films is indicated. Thus, it is concluded that whilst molecules of dextrose, lactose, sucrose and gum arabic form gaseous films over the entire range of concentration investigated, dextrin gives a non-condensed film at low concentrations, a condensed film above a critical concentration. Citrus and apple pectins give an intermediate type of film, glycogen a film approximating to a vaporous one. In the case of starch no conclusions could be drawn as to the surface orientation. On the basis of Dole's theory it is possible to calculate in a number of cases the energy of adsorption which characterises certain ring structures. AUTHOR.

3558. Influence of Temperature on Stability of Mineral Oil. F. P. Bowden, L. Leben and D. Tabor. *Faraday Soc., Trans.* 35. *pp.* 900–904; *Disc.*, 904–905, *Aug.*, 1939.—When a mineral oil is heated in the presence of air, compounds are formed in it which have a profound effect on its lubricating properties. These compounds change the frictional behaviour from "stick-slip" to continuous sliding and reduce the wear. The rate of formation of these compounds is much more rapid when the oil is present as a thin film on a steel surface than it is in bulk. The rate of formation is very dependent upon temperature. At room-temperature or at 100° C. the rate is slow even in a thin film, but it increases rapidly as the temperature rises and at 200° C. it may be fast. At temperatures near 300° C. other compounds are formed which decrease the lubricating properties of the oil. These observations have an important bearing on the behaviour of a lubricating oil in a running engine and on the testing of lubricants. AUTHORS.

See also Abstracts 3496, 3564, 3758, 3773.

TIME.

3559. New Precise Method for Finding the Clock Error by Coincidence with Hourly Signals. B. Gulotta. *Accad. Lincei, Atti,* 29. *pp.* 265–270, *March* 18, 1939.—The direct method of determining by ear the coincidence between the seconds of a clock and rhythmic signals leaves an uncertainty of $0^{s}\cdot 05$ in the clock error, determined from a single coincidence. A new method is proposed which will give a precision of about $0^{s}\cdot 0015$ from a single coincidence, and of about $0^{s}\cdot 0007$ from four or five. The principle is that both the beats of the clock and the hourly signals are transformed into light signals, and the problem of determining a very small time interval is reduced to the determination of the ratio of two lengths. Two intermittently luminous sources, controlled respectively by the clock and the signals, are made to produce images in the field of a microscope, coincidence of clock and signal being observed as a visual phenomenon. The optical principle involved, and the mechanical apparatus, are both described with diagrams. It is hoped to publish the practical results of this method in the near future. E. M. W.

3560. Choice of Stars in Meridian Observations. G. Bemporad. *Bull. géodésique, No.* 59. *pp.* 245–246, *July–Aug.–Sept.*, 1938.—The author replies to a criticism by Niethammer. [See Abstract 4373 (1938).] A. Hu.

3561. Date of Easter. J. M. Oudin. *Ann. Soc. Sci. de Bruxelles,* 59. *pp.* 225–256, *July* 12, 1939.—The author gives a general proof of Gauss's rule for finding the date of Easter merely from the year number. A simpler and more rapid form of the rule is established by transforming an exact formula, giving the date of Easter as a function of the Epact number and the Dominical letter, into one involving only the year number. It is further shown that the date of Easter can be obtained by seeking directly the date of the Sunday immediately following the Paschal full moon. Tables are given to facilitate the calculation, up to the year 5099, in both Julian and Gregorian calendars. A. Hu.

VISCOSITY AND FRICTION.

3562. Viscosities of Liquids and Saturated Vapours at High Temperatures and Pressures. K. Khalilov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 335–345, 1939. *In Russian.*—Curves and tables are given of the viscosities of various organic liquids and their saturated vapours as functions of temperature from room-temperature up to about 300° C., and these are compared with the results of other authors. D. S.

3563. Viscosity/Temperature Relationship in Molten Substances. E. Jenckel. *Zeits. f. phys. Chem.* 184. *Abt.A.* 4. *pp.* 309–319, 1939.—Following a discussion of the experimental data of various investigators, the author points out that the plot of log η against T^{-1} rises linearly at low viscosities and then much more rapidly as the viscosity becomes high. It is suggested that in the first-mentioned part of the curve the viscous flow is proportional to the fraction of active molecules present, while in the bowed part the flow of a single active molecule does not occur because it is walled in by inactive molecules ; in these circumstances flow could only occur of a number of contiguous active molecules. From this concept he derives the expression $\log \eta = \mathrm{MQR}^{-1}\mathrm{T}^{-1}(1 + x \exp.\mathrm{QR}^{-1}\mathrm{T}^{-1}) + \log A$, which agrees quite well with the experimental values observed. It is valid for ethyl alcohol in which the straight line part is known (and hence Q and A), but not for propyl alcohol, possibly because of dissolved water in the latter. For long molecules the activation heat Q is approximately that of the body only and does not vary greatly among different substances of varying molecular weight, on the other hand x diminishes as the tail shortens. The author does not favour Ward's extension of co-ordination number to molten materials, especially those with complex organic molecules. [See Abstract 1420 (1937).] D. R. H.

3564. Friction of Clean Metals and Influence of Adsorbed Gases. Temperature Coefficient of Friction. F. P. Bowden and T. P. Hughes. *Roy. Soc., Proc.* 172*A.* *pp.* 263–279, *Aug.* 3, 1939.—A method is described for measuring the kinetic friction between metal surfaces which have been freed from the oxide and surface films which are normally present. The removal of the films has a profound effect and the kinetic friction between the outgassed metals may be twenty times greater than that observed for the same metals cleaned in air. The addition of a trace of O_2 to the clean metal causes an immediate reduction in the friction. Adsorbed H_2 and N_2 have little or no effect. Although the friction is reduced by a single film it is clear that polymolecular layers are necessary before a substance can act as an effective boundary lubricant for moving surfaces. The temperature coefficient of friction between clean metals was determined over a wide temperature range. Most of the metals investigated show a small but regular decrease in the kinetic friction as the temperature rises. If the temperature causes excessive softening of the metal the friction may rise to a high value. AUTHORS.

3565. Mechanism of Sliding on Ice and Snow. F. P. Bowden and T. P. Hughes. *Roy. Soc., Proc.* 172*A. pp.* 280–297, *Aug.* 3, 1939.—Experimental studies of the friction on ice surfaces have shown that the low frictions observed at temperatures near the melting-point were due to lubrication by a thin water film at the points of contact between the sliding surfaces. The coefficient of kinetic friction was found to be independent of the load, apparent area of contact, and speed of sliding over a certain range. When the temperature of the ice was decreased, the friction rose markedly as the water film became more difficult to form. Using ski of various materials, it was observed that the friction depended very largely on the thermal conductivity of the ski. This result suggested that frictional heating played a large part in melting a water film during sliding; it had been previously considered that pressure melting was alone responsible for the formation of this water film. Experiments with miniature and real ski on snow surfaces showed that the same general laws were obeyed as on ice surfaces. The higher frictions obtained on snow were attributed to the extra work done in displacing and compressing the snow crystals. AUTHORS.

See also Abstract 3732.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***3566. Photoelectric Recording Photometer for Solar Spectrum. H. A. Brück.** *Roy. Astron. Soc., M.N.* 99. *pp.* 607–615, *June*, 1939.—A recording photoelectric photometer attached to the Cambridge McClean solar spectroscope is described which can be used for investigations of Fraunhofer line profiles without photographic procedure. AUTHOR.

***3567. Observations with Modified Pickering Polarigraph. Y. Öhman.** *Roy. Astron. Soc., M.N.* 99. *pp.* 624–633, *June*, 1939.—A brief survey is given on polarisation effects in celestial objects. A description is made of a new polarigraph constructed on a principle similar to that of Pickering's polarimeter of 1885. The instrument is tested on the moon and applied to a study of Hassel's comet and of obscuring clouds in the Great Andromeda nebula. AUTHOR.

***3568. Projection Micrometer Machine for Stellar Spectrograms. R. O. Redman.** *Roy. Astron. Soc., M.N.* 99. *pp.* 686–691, *June*, 1939.—A new machine for measuring stellar spectrograms is described.

It has been designed especially to minimise the fatigue experienced by the observer when measuring large numbers of plates. The image of the spectrum to be measured is projected on to a screen, lying in nearly the same plane as the writing paper on which results are recorded. Drum readings, also projected on the same screen, may be made to 1 μ without interpolation or the use of a vernier. The screw is operated by the left hand, the right being kept free for writing. The accuracy of the machine has been tested and its errors are shown to be negligible for all normal stellar spectroscopy.

COMETS AND METEORS.

3569. Age of Meteorites. F. A. Paneth. *Roy. Astron. Soc., Occasional Notes, No.* 5. *pp.* 57–64, *June,* 1939.—The He method of determining age (*i.e.,* period since final solidification) is the most reliable. Heating (*e.g.,* to 1000°) or distortion (*e.g.,* filing) has very little effect on the He content of metallic meteorites, while that of a stone is rapidly diminished. By applying the formula—Age = $(\mathrm{He}/\mathrm{U}) \times 8 \cdot 8 \times 10^6$ years, or $\mathrm{He}/0 \cdot 34\mathrm{Ra}$, or, taking into account that some of the He originates from Th, $\mathrm{He}/(0 \cdot 34\mathrm{Ra} + 2 \cdot 9 \times 10^{-8}\mathrm{Th})$—to an undistorted portion of a meteorite away from the surface, ages varying from 100 to 2800 $\times 10^6$ years are deduced as probable maxima. Thus none exceed the probable age of the earth. C. A. S.

3570. Wood's Mountain (N. C.) Meteorite. S. H. Perry. *Am. J. Sci.* 237. *pp.* 569–574, *Aug.,* 1939.—The meteorite described was found in 1918 near Wood's Mountain, McDowell County, North Carolina. The mass is much weathered, flat on one side and rounded on the other, weighing 3017 gm. when received by the writer. It is a finest octahedrite, with a relatively low Ni content and very little P. An analysis by F. A. Gonyer is given. A zone of alteration is present, in which occur intrusions of magnetic oxide surrounding minute areas of iron which have recrystallised with a dendritic structure. The writer is not aware of any published reference to the occurrence of dendrites in meteoric irons, and he has observed it in only one other iron. The meteorite is preserved chiefly in the United States National Museum. AUTHOR.

See also Abstracts 3567, 3575.

COSMOGONY.

3571. Origin of Solar System. W. J. Luyten. *Roy. Astron. Soc., M.N.* 99. *pp.* 692–696, *June,* 1939.—Lyttleton's reply [see Abstract 3138 (1938)] to the criticisms advanced by Hill and Luyten against his theory for the origin of the solar system are reconsidered. It is shown that Lyttleton's arguments, claiming to establish a favourable case for an intruding star much more massive than the sun are in error both qualitatively and quantitatively. In particular it is here shown that (1) it is exceedingly improbable that the sun could capture any part of the filament, without itself becoming captured by the intruder ; (2) even in the situation most favourable to capture the sun must have been running roughly parallel to the filament for some time, and must itself have suffered a close approach or collision with the intruder—which possibility was distinctly ruled out by Lyttleton's postulates ; and (3) Lyttleton's invoking of a special star such as a yellow giant to engender the planetary system is shown to be not only physically inadequate because of the low density of such stars, but further to increase the already enormous odds against the occurrence of such a collision. [See also Abstracts 1534 and 3183 (1939).] AUTHOR.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

3572. Apsidal Motion in Binary Stars. Parts II and III. T. E. Sterne. *Roy. Astron. Soc., M.N.* 99. *pp.* 662–672, *June*, 1939.—The theory of the apsidal motion [see Abstract 2399 (1939)] has been applied to the eclipsing stars Y Cygni, GL Carinæ, H.V. 7498, YY Sagittarii and V 523 Sagittarii. If these stars are binary systems, then they should be expected to show the observed apsidal motions if their components are polytropes with indices of $3 \cdot 02 \pm 0 \cdot 12$, $3 \cdot 01 \pm 0 \cdot 15$, $3 \cdot 46 \pm 0 \cdot 44$, $2 \cdot 83 \pm 0 \cdot 20$ and $3 \cdot 80 \pm 0 \cdot 23$ respectively. The probable errors that are assigned to these indices are rough values, based upon the estimated accuracies of the quantities from which the indices have been determined. A lower limit to the ratio of central to mean density, in the more concentrated component of an eclipsing binary star, may be inferred from the observed apsidal motion. This lower limit may be observationally determined, without any appeal to the theory of the internal constitution, and without making any assumption, concerning the nature of the stellar model, other than that the density is not to increase outwards. The lower limits thus found have for Y Cygni, GL Carinæ, H.V. 7498, YY Sagittarii and V 523 Sagittarii the values $10 \cdot 9 \pm 1 \cdot 6$, $10 \cdot 7 \pm 2 \cdot 2$, 20 ± 12, $8 \cdot 8 \pm 2 \cdot 3$ and 32 ± 10 respectively. The probable errors are rough values, based upon the estimated accuracies of the quantities from which the lower limits have been determined. It is probable that the lower limits are considerably smaller than the actual ratios. AUTHOR.

3573. Retrograde Apsidal Motion. H. Fabre. *Comptes Rendus*, 208. *pp.* 2054–2056, *June* 26, 1939.—The nature of apsidal motion is considered for orbits in a gravitational field derived from a potential comprising, amongst others, that exercised by Jupiter on an asteroid, and that between the components of an eclipsing binary. For orbits of more than a certain minimum eccentricity, the line of apsides is shown to suffer a secular advance or, in some cases, a libration. In the restricted planetary problem, it is found that the secular inequalities of order > 1 in the expression for the apsidal displacement may sum to a value comparable to the first-order secular inequality. In these circumstances the positive apsidal motion may be more than doubled or counterbalanced; thus for an asteroid in the critical zone, the mean displacement of perihelion may be direct at one boundary of the zone but retrograde at the other. A. HU.

See also Abstracts 3551, 3552, 3640.

LATITUDE AND LONGITUDE.

See Abstract 3538.

NEBULÆ.

3574. Interpretation of Spectroscopically Observed Rotations of Galaxies. E. Holmberg. *Roy. Astron. Soc., M.N.* 99. *pp.* 650–661, *June*, 1939.—Rotations have been established for several extragalactic objects by means of spectroscopic observations. The *linear* increase of observed radial velocity found for N.G.C. 4594 and the central part of N.G.C. 224 is a matter of great theoretical interest. Several attempts to explain this have been put forth, such as the assumptions of a linear law of attraction, a constant mass density, or a large internal viscosity. The present paper gives a fourth explanation. By paying due attention to the absorption within a galaxy and to the relation between observed radial velocity and corresponding orbital velocity, the author finds that Newton's law of attraction will result in more or less linear relations of the above kind. AUTHOR.

See also Abstract 3580.

PLANETS.

3575. Colour Index of Uranus. Photometric Observations and Colour Index of the Nucleus of Comet Kosik-Peltier. L. Gialanella. *Accad. Lincei, Atti*, 29. *pp.* 198–204, *March* 4, 1939.—The colour index of Uranus has not been determined with certainty. The author, from a series of observations made during the opposition of 1938–1939, obtains the value $+\ 0^{\mathrm{m}}.685 \pm 0^{\mathrm{m}}.005$. The comet Kosik-Peltier (1939 *a*) was observed from its perihelion passage on Feb. 7 and on seven other evenings with a view to obtaining both the colour index and the magnitude of the nucleus. Results are given in several tables and graphs. The general conclusions are that (1) the colour index decreases continuously after perihelion passage, and (2) the shape of the light curve indicates real variation of magnitude in the nucleus rather than effects of phase or varying absorption by the material of the comet. E. M. W.

3576. Chemical Nature of Coloration in Jupiter's Cloud Forms. R. Wildt. *Roy. Astron. Soc., M.N.* 99. *pp.* 616–623, *June*, 1939.—The reaction between NH_3 and metallic Na produces highly coloured systems, both liquid and solid. With due regard to conceivable differences in temperature, it appears possible to render account of the whole range of colours observed on Jupiter and of the absence of vivid coloration from Saturn's surface. The origin of the elementary Na involved must be left undecided at present. AUTHOR.

See also Abstracts 3567, 3571, 3581.

STARS.

3577. Spectrometric Study of Faint Stars in the Pleiades Region. L. Gratton. *Stockholms Obs. Ann.* 13. 3. [75 *pp.*], 1939. *In English.*—The author investigates faint star spectra as concerns apparatus, material, criteria and methods. He finds it probable that the Pleiades nebula is a marginal part of the large Taurus cloud shining by scattered or reflected light from bright cluster stars where it is dense enough; in this region obscuration seems denser in S-W parts than in N-E. Between the sun and Pleiades, space density is constant up to 500 ps., then decreases rapidly to 1/10 its value at the sun, when at 1500 ps. The Pleiades stars of each spectral type are fully identical, but the physical members display a cosmical error of the spectrophotometric *M*s, which depends considerably upon the stars' spectral types. The Pleiades are thus very abnormal as regards the field stars, which latter show no systematic difference depending on the relation of cyanogen absorption (*cκ*) to M. A. S. D. M.

3578. Minimum Central Temperature of a Gaseous Star. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 99. *pp.* 673–685, *June*, 1939. —The problem of determining the minimum central temperatures of gaseous stars is solved. It is shown that in any equilibrium configuration in which the temperature and the density do not increase outward the minimum central temperature is attained in the sequence of equilibrium configurations consisting of isothermal cores and homogeneous envelopes. By a study of the appropriate sequence of composite configurations it is found that $(T_c)_{\mathrm{min}} = \frac{1}{2}Q_{\mathrm{min}}(\mu\mathrm{H}/k)\,(GM/R)$, where Q_{min} is a dimensionless quantity depending on $M\mu^2$ only. Q_{min} is tabulated as a function of the mass of the star expressed in a suitable unit (M_3). Numerical applications are also given. AUTHOR.

3579. Hydrogen Content of White Dwarf Stars in Relation to Stellar Evolution. A. S. Eddington. *Roy. Astron. Soc., M.N.* 99. *pp.* 595–606, *June,* 1939.—Most discussions of our theoretical and observational knowledge of white dwarfs have been based on the Stoner-Anderson degeneracy formula which the author considers to have been disproved in his earlier papers. There is therefore need for a study of these stars based on the earlier formula which appears to be correct. The elementary formulæ are put into suitable form for practical use. The chief application is to determine the H content of three white dwarfs for which data are available. Special attention is directed to the large H content found for the companion of Sirius. This is crucial in theories of transmutation and stellar evolution, since it is often assumed in such theories that stars only pass to the white dwarf state after having exhausted their H content. The difficulty of reconciling Bethe's transmutation theory with the existence of H-containing white dwarfs is considered, and alternative ways of meeting the difficulty are discussed; one alternative in particular has interesting astronomical consequences. But serious difficulties remain outstanding, and the author re-examines the trustworthiness of the evidence for large H content. The evidence, however, proves to be very difficult to upset. AUTHOR.

3580. Effect of Absorption on Apparent Distribution of the Stars. K. G. Malmquist. *Stockholms Obs. Ann.* 13. 4. [31 *pp.*], 1939. *In English.*—The fundamental integral equation is derived connecting the observed frequency distribution of apparent magnitudes, the assumed frequency function of absolute magnitudes, the true density distribution of the stars in space, and the space absorption. An alternative and more simple form of the fundamental equation, which allows the use of a simple geometrical construction, is derived: its value is particularly in determining the distance, radial extension, and amount of absorption of a dark nebula. The equation is applied to computing the apparent magnitude function for two artificial cases where the position, form, and absorption of the nebulæ are known. Working backwards from these results, the ordinary Wolf diagrams constructed from the given data in these cases are shown to lead to erroneous values of the distances and dimensions of the nebulæ, whereas the new equation gives a very good representation of the original assumptions. The new method is applied to the dark nebula in Auriga: the obscuration is found to be due to a thin cloud at 200 psc. absorbing 1·25 mag., and a second cloud at 400–500 psc. absorbing 0·75 mag. A. Hu.

3581. Progress in Astrophysics. *Am. Phil. Soc., Proc.* 81. 2. *pp.* 107–307, 1939.—Reports of a symposium held in February, 1939, consisting of the following 10 papers.

"Problems of the Solar Atmosphere," by **D. H. Menzel** (*pp.* 107–124). —The present state of the theory interpreting the formation of absorption lines is summarised, and our knowledge of atmospheric motion and the fields of force causing it is outlined. Dilution and the quality of radiation are considered as contributing causes to departures from thermodynamic equilibrium. Theories of chromospheric support which attribute calcium levitation to radiation pressure or to turbulence are not yet satisfactorily confirmed. The forces producing motion in eruptive prominences are reviewed : some sort of equilibrium between gravitation and radiation pressure is considered likely but is difficult to account for. The question is complicated by the existence of magnetic and possibly of electric fields.

" Composition of the Sun," by **C. M. Sitterly** (*pp.* 125–133).—In a discussion of available spectroscopic data on elements present in the sun, the author concludes that 64 are certainly present, 19 are absent (3 having accessible ultimate lines, 11 inaccessible, and 5 not being expected owing to short radioactive life), whilst the solar data are inadequate for 2 and the laboratory data inadequate for 7. Abundance data show a general correspondence between the sun's composition and that of the accessible crust of the earth, except that H and He are far more common on the sun.

" Constitution of the Planets," by **R. Wildt** (*pp.* 135–152).—The geodetical, geophysical, and geochemical lines of approach are outlined. The simplicity of gaseous matter is replaced in the planets by the complexity of condensation into molecules, crystals, colloids, and living organisms. The distinction between the terrestrial and the giant planets is brought out in tables which list the mechanical data and temperatures of the planets, and is also present in the planetary atmospheres. The history of both types is sketched from primeval condensation, and the high central condensation of matter in the giant planets is examined. The structure of planetary satellites, asteroids, and meteors is touched upon.

" Internal Constitution of the Stars," by **S. Chandrasekhar** (*pp.* 153–187).—The mathematical attack on the problem is divided into 3 parts : the method of the integral theorems, that of the homologous transformations, and the approach from a consideration of stellar envelopes. The first establishes the orders of magnitude of the physical variables in stellar interiors ; the second considers the point-source model, the model in which the energy-sources are uniformly distributed, and the intermediate standard polytrope, and draws inferences as to atomic abundances in the Hertzsprung-Russell diagram ; the third exhibits the breakdown of the standard model with massive stars. The function of degeneracy in white dwarfs is also described.

" Variable Stars," by **C. Payne-Gaposchkin** (*pp.* 189–210).—The author describes the plan for a comprehensive, coherent, and quantitative survey of stellar variability from Harvard patrol plates. The precision of the observational results is to be found by using the eclipsing variables as standards. The type of result that can be obtained concerning the light curves and their variations, and in fortunate cases the spectra and their variations, is illustrated by typical examples. A general method is suggested for the comparative study of red long-period variables. Definitive elements and light curves for 1000 of the brighter variables are hoped for.

" Stars with Extended Atmospheres," by **O. Struve** (*pp.* 211–250).—The nebular envelopes surrounding Be and Ae stars are discussed. The weakness of Mg II 4481 and Si II 4128, 4131 is attributed to the fact that their lower states are not metastable : the source of radiation being distant and the dilution factor accordingly small, atoms accumulate in the ground level and mestastable levels. The phenomenon allows calculation of the dilution and hence of the extent of the atmosphere. The theory of cycles and the problem of the distribution of the atoms of an element amongst its various energy levels are investigated without assuming unit dilution or metastability. The relations obtained are illustrated by particular reference to Nova Herculis, an atlas of spectra from outbust to mid-March being given from λ3900 to Hβ.

" Physical Characteristics and Origin of Supernovæ," by **F. L. Whipple** (*pp.* 253–264).—Observations of supernovæ: their light variations, frequency of occurrence, and spatial distribution with respect to the centres of their associated external galaxies, are discussed with a view to explaining their origin. The wide spectral bands are interpreted as evidence of expansion, and the absence of H lines suggests that the expelled shell is composed, unlike in ordinary novæ, of interior matter of low H abundance. The total energy radiated is of the order of 10^{50} ergs, but the effective temperature and radius at maximum are not likely to be widely different from those of ordinary stars. Observation cannot at present distinguish between the rival theories of origin, *viz.*, collapse of a single star to a degenerate or neutron core, and collision of two stars.

" Observations of Supernovæ," by **D. Hoffleit** (*pp.* 265–276).—The history of the discovery of the 21 known supernovæ is reviewed, and the present state of Zwicky's " seven characteristics " discussed. The author presents the observational data available for the determination of the absolute magnitudes (from apparent magnitudes and distance moduli of parent nebulæ) and of the total energy radiated (from integration of the light curves).

" Material of Interstellar Space," by **T. Dunham, Jr.** (*pp.* 277–293). —A list is given of the expected and discovered interstellar lines, and a plate shows the entire interstellar spectrum. The ratio of Ca I to Ca II observed from H, K, and λ4226 is used to calculate the degree of ionisation in space, whence, knowing the quality and intensity of interstellar radiation, the electron density in space and the numbers of other elements in each stage of ionisation can be derived. This process is carried through for data obtained from the spectrum of χ^2 Orionis, and therefore represents a sounding of space in one direction only. With this restriction the results are given in the form of numbers of particles (electrons, atoms and ions of H, Na, K, Ca, and Ti) in a cubic metre of interstellar space.

" Stellar Energy," by **H. N. Russell** (*pp.* 295–307).—After giving a non-mathematical account of recent theoretical developments explaining the mass-luminosity relation and the general features of the Hertzsprung-Russell diagram, the author discusses various nuclear reactions as sources of stellar energy. Bethe's process, in which C acts as a catalyst for the transformation of H into He at temperatures above 15 × 10^6 deg., explains the radiation of main-sequence stars, but giants still present an unsolved problem. A. Hu.

See also Abstracts 3567, 3568, 3572, 3574.

SUN.

3582. Study of Solar Corona and Prominences without Eclipses. B. Lyot. *Roy. Astron. Soc., M.N.* 99. *pp.* 580–594, *June*, 1939.—The author describes previous attempts, and for their failure gives lens diffusion and diffraction at its edge; also his own observations on Pic du Midi, (1) in 1930–34 when he tested his new method, and after 1934 when he obtained new results; both by means of the polarimeter. Plates show; (1) Direct photography of the corona, exhibiting much detail—wide streamers, dark gaps and luminous arches, and brightest prominences. (This method shows only the inner corona up to 7′ from the sun's edge.) A tangential trail of Mercury on 1937 May 11, indicates that this planet's atmosphere when in front of the corona diffuses light feebly, with refraction less than 1/30 earth's; (2) the spectrum of the corona; (3) of prominences; (4) of these through coloured filters; (5) of their movements. In direct coronal photographs, those without eclipse show inner corona only; within eclipse, the outer parts only. A. S. D. M.

3583. Motion of Solar Prominences and Streamers. H. R. Hulme. *Roy. Astron. Soc., M.N.* 99. *pp.* 634–641, *June*, 1939.—Pettit's two laws for the motion of prominences and streamers are discussed. The conclusion reached is that the second law is unfounded, and that the application of the first law to the case of descending streamers is not yet justified. [See Abstracts **3012** (1937), **4411** (1938) and **187** (1939).]

AUTHOR.

3584. Horizontal Diameter of the Sun. G. Armellini. *Accad. Lincei, Atti*, 29. *pp.* 235–240, *March* 4, 1939.—Daily measures, whenever possible, of the solar diameter have been made without a break from 1873 at the R. Osservatorio del Campidoglio at Rome. The results up to the end of 1933 have been published in various papers. This paper gives the results of the last four years, which conclude the series, the apparatus having been removed to another observatory in August 1937. The method of observation has been constant for the whole series. The solar image and the micrometer wires were projected on to a white screen and the instant of transit of both limbs of the sun were observed over seven wires by four observers by the " eye and ear " method. Numerical results showing the slight variations in the angular radius of the sun and the personal equations of the four observers are given in several tables. The final value of the solar radius is determined as 961″·49 which is in almost exact agreement with that of 961″·50 adopted in the " Berliner Astronomisches Jahrbuch".

E. M. W.

See also Abstracts **3566, 3581, 3826, 3827, 3828.**

GEOPHYSICS.

GEOPHYSICS, APPLIED.

3585. Radio-Propagation Methods in Applied Geophysics. V. Fritsch. *ATM No.* 96. *V*65–14, *June*, 1939.—Near a radio transmitter the variation of field strength over the ground depends on the underlying geological structure, hidden watercourses, ore inclusions, etc. A brief account of the methods used to measure such field variations is given; and examples of the types of field strength curves which results from various underground formations, are shown diagramatically. J. P. A.

HYDROSPHERE, PHYSICS OF THE.

✱3586. Apparatus for River-Maritime Oceanography. E. Pelerin. *Comptes Rendus*, 208. *pp.* 2097–2099, *June* 26, 1939.—For use in estuaries where the percentage error in measurement of depth, which arose with the earlier form of sampling bottle [see Abstract 2435 (1939)], is appreciable a new form of apparatus was devised. Its details are shown in a diagram and described. No filtering of the suspended matter occurs, when taking a sample, for organisms up to 6 × 6 cm. The tap for closing the bottle has an adjustable speed. The bottle has a large size port hole for examination of the sample and it is able to resist the effects of current flow. R. S. R.

LAND, PHYSICS OF THE.

3587. Continental Drift. J. S. Lee. *Geolog. Mag.* 76. *pp.* 289–293, *July*, 1939.—Any altered arrangement of land masses must give rise to distortion and changes in the structure of these masses. It is stated that sufficient consideration has not been given to this view in dealing with continental drifts. Distortion in the Pacific basin as a whole is discussed, using the evidence of the directrices of the American mountain masses, the Pacific Islands and Australia. It is explained how this may be used to account for the breaking away of Australia from Antarctica and the resulting movements of the crust and sub-crustal layers which accompanied this change. R. S. R.

3588. Crystallographic Investigation of Glacier Structure and Mechanism of Glacier Flow. M. F. Perutz and G. Seligman. *Jungfraujoch Research Party*, 1938. *Publ. No.* 1. *Roy. Soc., Proc.* 172*A*. *pp.* 335–360, *Aug.* 23, 1939.—The mechanism of glacier flow and the transformation of firn into glacier ice have been investigated on the Great Aletsch Glacier and in neighbouring regions. The following results were obtained : (1) During the transition of firn into glacier ice the air spaces, forming a system of intercommunicating capillaries in the firn, become reduced in number and separated from each other by compression and by the growth of the crystals. This growth is primarily effected by the refreezing of melt water retained in the capillaries. (2) A large percentage of the firn crystals near the surface of the *névé* lie with their hexagonal axes at right angles to the surface of the glacier. This orientation appears to be part of a general rule whereby recrystallisation of snow by melting and refreezing or by sublimation involves a reorientation of the crystals with their axes parallel to the direction of the temperature gradient. (3) In the course of 6–8 years the initial orientation of the crystals near the surface gives way to a random distribution. Large thrust planes are absent in the *névé*. (4) Stratification bands in the *névé* formed by the freezing of wet strata of firn have no connection with any irregularities in the differential movement. The orientation of their crystals is similar to that of pond ice. (5) Examples both of non-laminar and of laminar motion were observed in the glacier tongue. In places where the ice was subjected to shear the crystals were orientated with their basal planes parallel to the direction of shear. A mechanism of plastic deformation is proposed which accounts for these findings and is based on the growth of deformation and reorientation of the crystals. The paper is illustrated by 8 diagrams and 11 photographs. H. H. Ho.

METEOROLOGY.

3589. Atmospheric Ozone. E. Vassy. *J. de Physique et le Radium,* 10. *p.* 250, *May,* 1939.—This short note consists of criticisms of the methods used by Barbier and Chalonge, recorded in a recent paper dealing with observations on the thickness, temperature, etc., of the atmospheric ozone layer [see Abstract 1994 (1939)]. In reply, **D. Barbier and D. Chalonge** [*ibid.* 10. *pp.* 324–325, *June,* 1939] discuss the advantages and disadvantages of the two methods used in greater detail than in the previous paper. E. E. W.

3590. Upper Atmosphere. *Roy. Meteorolog. Soc., J.* 65. *pp.* 303–328 ; *Disc.,* 328–336, *July,* 1939.—The scope of the discussion as indicated by F. A. Paneth in his opening remarks is limited to two aspects, (A) the composition, and (B) the density and the temperature of the upper atmosphere. The general discussion follows consideration of these two points.

A. COMPOSITION OF THE UPPER ATMOSPHERE.

"Direct Chemical Investigation," by **F. A. Paneth** (*pp.* 304–310).—The analysis of air samples from the stratosphere show best the extent to which the air in that region may be considered to be at rest. A table gives the composition of air at the surface. When air samples taken from all parts of the globe are examined the results, which are given in tabular form, show a diffusive separation setting in at about 20 km. They do not indicate perfect quietude above this level. The composition of the air remains therefore nearly constant up to the heights examined.

"Spectroscopic and other Evidence as to Chemical Composition and Dissociation," by **S. Chapman** (*pp.* 310–314).—The spectrum of the auroral light indicates a N_2-O_2 atmosphere up to 600 km. Reasons for this composition are given. Also the spectra show bands due to molecular N_2 and lines due to atomic O. This dissociation of O_2 is caused by u.v. light. The chemistry of the upper atmosphere is therefore considered to be that of $N_2 + O_2$ with O_2 in various forms.

"Vertical Distribution of Ozone," by **G. M. B. Dobson** (*pp.* 314–319).—The reasons for the interest in the vertical distribution of O_3 having been stated the methods of determining it are given in detail. A series of curves shows the results of investigations made at Arosa and Tromsö. The distribution shows a maximum between 20 and 30 km.

B. DENSITY AND TEMPERATURE OF THE UPPER ATMOSPHERE.

"Direct Measurement and Sound Evidence," by **F. J. W. Whipple** (*pp.* 319–323).—After referring to early work on upper air temperatures, the author deals with the results of soundings made in recent years. These for the most part, however, reach to heights of about 25 km. only. The use of sound waves has made it possible to explore to heights of 50 to 60 km. Direct measurement shows a falling off of temperature up to heights ranging from 8 to 17 km. according to latitude and season with a nearly constant value above. Sound wave observations indicate a rise in temperature again, reaching a maximum about 50 km.

"Meteor Evidence," by **F. A. Lindemann** (*pp.* 323–324).—Four reasons are deduced from the observations of meteors which indicate that the density and temperature of the upper air are higher than correspond to 220 K. the previously accepted value. The observations indicate that at great heights the temperatures rise to 300 or 400 K., and consequently the density is some 100 times higher than it would be if a constant temperature of 200° K. existed above 10 km.

"Structure of the Atmosphere as Deduced from Ionospheric Observations," by **E. V. Appleton** (*pp.* 324–328).—From these observations it is evident that there exists some influence in the upper atmosphere which tends to spread it out. This must be due either to increased temperature or to the presence of a light gas. Now experimental data relating to variation of ionisation with height give information regarding the way a particular component varies with height. So it becomes possible to estimate air densities from measurements of electron frequencies.

C. GENERAL DISCUSSION.

D. F. Martyn discussed first the constitution of the atmosphere at great heights and its alteration with the weather at the ground, a possible link being provided by the variation known to occur in the O_3 layer. Thereafter he turned to the temperature distribution and concluded that the weight of the evidence in favour of the scheme put forward by Martyn and Pulley was now very considerable.

J. A. Ratcliffe stated that reflection of very long radio waves at a height of about 75 km. indicates a temperature of about 200 K.

F. A. Lindemann referring to the composition of the upper atmosphere deals at length with the case of He and concludes that in the outermost region it must form a considerable portion of the gases present. The origins of the various ionised layers are also closely examined and reasons for each advanced. In particular the F_2 layer is examined, and its suggested cause offers an explanation of several observed phenomena. A. E. M. G.

3591. Main Problems of Meteorology. H. Philipps. *Naturwiss.* 27. *pp.* 427–432, *June* 23, *and pp.* 442–450, *June* 30, 1939.—The author discusses first the similarities in the treatment of classical hydrodynamics of a fluid and dynamical meteorology. Next the differential equations of theoretical meteorology and their solution are set out. The static structure of the atmosphere and the vertical activity of weather situations are described and an outline given of the advection theory. The conditions of equilibrium, stationary problems in the dynamics of the atmosphere, and the deviation from the geostrophic wind are treated. These factors lead to a general consideration of the problem of the structure of the cyclone and the pressure distribution at the ground and higher levels. R. S. R.

3592. Theory of Convection. S. Petterssen. *Geofysiske Publ.* 12. 9. [23 *pp.*], 1939. *In English.*—The general conditions of stability and instability in the atmosphere are discussed. Two methods of testing the stability are used (1) the parcel method, in which the energy available is given by the area enclosed between the ascent curve and the curve of adiabatic or pseudo-adiabatic movement but the results are approximate, and (2) the slice method which applies to all significant classes of stratification and conditions, gives more accurate values of the available energy, and the stability criteria are the same as for (1), but it is less applicable to aerological observations. Each method is described and discussed and examples given of their use. Tables of criteria for stability and instability for saturated and non-saturated air are supplied. Convective currents are discussed in a general way and the results are then applied to the formation of cumulus clouds and their development from the humilis to the congestus and cumulo-nimbus clouds and their several modifications. R. S. R.

3593. Formation and Dissipation of Fog. S. Petterssen. *Geofysiske Publ.* 12. 10. [22 *pp.*], 1939. *In English.*—The physical processes which give rise to the formation of fog under favourable conditions and the counteracting influences which may lead to the dissipation of fog are explained. From this discussion the fog-producing and fog-dissipating agencies are classified. For the former (1) evaporation gives rise to rain area or frontal fog and steam fog, (2) cooling gives rise to upslope fog, isobaric fog, isallobaric fog, radiation fog and advection fog, and (3) mixing in the horizontal has a slight effect. For the latter (1) sublimation or condensation on snow for air temperatures above or below 0° C., (2) heating due to downslope motion, flux across the isobars, rising pressure, absorbed radiation, or advection over a warmer surface, and (3) vertical mixing, all act to a greater or less extent in dispersal. In many cases one or more of the fog-producing or fog-dissipating processes may be in operation. R. S. R.

3594. Effect of Interstellar Matter on Climatic Variation. F. Hoyle and R. A. Lyttleton. *Cambridge Phil. Soc., Proc.* 35. *pp.* 405–415, *July,* 1939.—The effect of interstellar matter on the sun's radiation is considered with a view to explaining changes in terrestrial climate. It appears that a star in passing through a nebulous cloud will capture an amount of material which by the energy of its fall to the solar surface can bring about considerable changes in the quantity of radiation emitted. The quantity of matter gathered in by the star depends directly on the density of the cloud and inversely on the cube of its velocity relative to the cloud. Thus vastly different effects on the solar radiation can be brought about under fairly narrow ranges of density and relative velocity (ranges that are in accordance with astronomical evidence). In this way the process is able to explain the small changes in the solar radiation that are necessary to produce an ice age and, under conditions less likely to have taken place frequently, the high increase in radiation required for the Carboniferous Epoch. Despite the large effects that the mechanism can bring about, it is shown that the mass of the sun does not undergo appreciable change and hence reverts to its former luminosity once the cloud has been traversed. AUTHORS.

3595. Fringe of Atmosphere and U.V. Light Theory of Aurora and Magnetic Disturbances. S. K. Mitra and A. K. Banerjee. *Indian Journ. Phys.* 13. *pp.* 107–144, *April,* 1939.—The paper is divided into two parts, (1) the fringe of the atmosphere, and (2) the u.v. theory of the aurora. The fringe which exists beyond the limits of the upper atmosphere, is regarded as containing molecules moving without collision and describing immense orbits. The height of this region of negligible collision is calculated to be 770 km. Molecular densities at different levels in the fringe are estimated and the merging of the fringe into interstellar space is regarded as taking place between 2000 and 2500 km. above the earth. If account be taken of collisions between neutral particles and atoms or molecules excited to metastable states by incident solar radiation, then the spray region is found to extend to 14000 km. These results are not quite in accordance with Hulbert's theory of auroræ; the differences are discussed. In the second part, where the motion of an ion in the earth's magnetic and gravitational fields is investigated, differences with Hulbert's theory are also encountered. The authors consider however, that with increase of spectroscopic knowledge of the high atmosphere new facts may be revealed which would explain the discrepancies. A. E. M. G.

3596. Height and Spectra of Auroræ over Southern Norway, 1936. C. Størmer. *Geofysiske Publ.* 12. 7. [42 *pp.*], 1939. *In English.* —Some of the results from auroræ in this period have already been examined [see Abstract 3503 (1937)]. In the present paper certain selected sets from April 20–22 and Oct. 16–17 are considered in detail. Particulars are given of the methods of measurements of the plates and of improvements in the reduction of the plates in order to measure heights. Graphical methods of finding the position of the earth's shadow in the region of the auroræ are set out. A discussion of the results obtained on the selected nights follows. The heights of the lower borders and of the summits of sunlit rays of the April auroræ are found to be about 90 km. and from 300-600 km. respectively. Many details are given concerning the forms and appearance of the October aurora. The spectra of these forms are examined and the intensities of the various lines compared. The numerical results of the observations are set out in a series of tables, and the positions of the auroræ indicated by diagram, while a large number of photographic reproductions show the general appearance of the phenomena. Photographs of the spectra are also reproduced. A. E. M. G.

3597. Auroral Spectrum. L. Vegard. *Geofysiske Publ.* 12. 8. [10 *pp.*], 1939. *In English.*—A résumé of the present position in this field. A. H.

3598. Characteristics of Auroræ in New Zealand. M. Geddes. *Terr. Mag.* 44. *pp.* 189–193, *June*, 1939.—A summary of observations during the last six years is given. This includes tables of frequency of occasions and intensities. During this period of change from minimum to maximum frequency increased definition has resulted. The various types observed, pulsating forms, nebulous bands, and unusual forms are described. The maximum frequency occurs at 2200–2230 hours, local time. The forms and changes observed with sunlit auroras are also described. The lower border of auroras is 86–112 km. during the last four years, and the maximum summit obtained photographically is 298 km. The arcs lie perpendicular to the lines of magnetic force. Some results relating to the behaviour of radio signals during the progress of an aurora are given. R. S. R.

3599. Primary and Secondary Scattering of Sunlight in a Plane-Stratified Atmosphere of Uniform Composition. A. Hammad and S. Chapman. *Phil. Mag.* 28. *pp.* 99–110, *July*, 1939.—The investigation has been limited to wave-lengths for which transformations from or to other wave-lengths, by absorption or emission can be neglected, and refraction or polarisation of the light is not considered. Full account is taken of the Rayleigh law of scattering and the results thus differ from an earlier approximate treatment. Expressions are obtained for the emission and reception of primary and secondary scattered sunlight. To use the expressions with actual observations of scattered sunlight the formulæ for the reception must be evaluated numerically. For primary scattering there is no difficulty but for secondary scattering there is much more difficulty. For tertiary scattered sunlight the expressions for intensity are too lengthy and elaborate for numerical evaluation and discussion. R. S. R.

***3600. Integrator for Polar, Rectangular and Curvilinear Coordinates. J. Lugeon.** *Comptes Rendus*, 208. *pp.* 1874–1876, *June* 12, 1939.—The integrator described earlier for polar coordinates [see Abstract 2448 (1939)] can be transformed into one based on rectangular coordinates if for the circular movement of the pole of the pantograph a linear movement parallel to the polar of this pole with reference to the disc is substituted. It is shown that the three conditions of mechanical integration are fulfilled by the adjustments made and a diagram is given to illustrate these new features of the apparatus. It can also be transformed into an integrator for curvilinear coordinates in the cases of a galvanometer and a Richard recorder. R. S. R.

SEISMOLOGY.

3601. Dispersion of Seismic Surface Waves. H. Menzel. *Gerlands Beitr. z. Geophys.* 54. 4. *pp.* 348–369, 1939.—A dispersion curve for transverse waves was derived from the records of the Wiechert seismographs at Copenhagen and Gross-Raum. Mathematical treatment of the dispersion equation for a 2-layered medium shows that the observed dispersion curve can be brought into agreement with the theoretical by interpreting the wave velocities as group velocities. W. A. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3602. Ionisation of Fire-Damp. L. Funder. *Gerlands. Beitr. z. Geophys.* 54. 4. *pp.* 370–449, 1939.—The small- and large-ion content of the air in coal, salt, and mineral mines is measured and the process described. The small-ion content of the Westphalian coal mines and the Hanover salt mines was scarcely different from that of the atmosphere, but in the Hartz lead-zinc mines it was from 10 to 30 times higher. The large-ion content did not reach the expected high value. With increasing length of the damp-stream ionisation increased owing to enrichment of the damp with Rn. Explosion vapour as well as floating coal and salt dust in mines is, from the electrical standpoint, vastly different from the usual aerosol. It not only forms large-ions but has a self-activity through adsorption of emanation by salt, so that both small and large ions increase equally. By this means the increase of the large ion in coal dust was small, in salt dust considerable, and in explosion vapour extraordinarily high. The small-ion content rises to twice or three times its original value. Decrease of pressure increases the ionisation. In moving fire-damp the ion content is some 10% greater than under still conditions. W. A. R.

3603. Observations of a Spherical Thunderbolt. R. Garreau. *Comptes Rendus*, 209. *pp.* 60–61, *July* 3, 1939.—Details are given of the effects accompanying a violent thunderbolt at Rochefort-sur-Mer on April 26, 1939. It followed heavy rain and was accompanied by a violent lightning flash which forked and struck the ground at three places. At the first there was a luminous dark brick-red ball without protuberances or odour and about 15–20 cm. in dia., which disappeared near the ground, an adjoining house being also struck by lightning. At the second point a ball of light of similar size struck a crane, damaging the equipment and injuring workmen near by. At the third the ball of light was smaller and appeared to roll on the ground before disappearing. R. S. R.

3604. Magnetic Declination in the Pacific from Observations by the Galilee and Carnegie. C. R. Duvall. *Terr. Mag.* 44. *pp.* 115–136, *June*, 1939.—The declination is expressed by a rational, integral algebraic function of the second degree of the latitude, longitude and time, and the observations used were those of the first, second and third cruises of the Galilee and of the second, fourth, fifth, sixth and seventh cruises of the Carnegie. All the observations of both ships were given equal weight, and the observations at over 2000 stations were used. The whole work is summarised in a table of coefficients and other data referring to the particular squares into which the Pacific was mapped. A declination map of the Pacific shows the small oval near the middle where the declination has a minimum value of 8° E. for the 160° meridian, the increase, north and south to over 30° E., and the 0° isogonal in the west. The annual change of declination is expressed by differentiating the first equation with respect to time. This gives, for a given square, the isopors of declination within the square. The results of analysis of observations for the different squares are also tabulated. Five magnetic observatories lay within the limits of the squares, and it was thus possible to compare the sea and land observations. In general, the sea value was higher than the land value. The differences in these are discussed. G. E. A.

3605. Giant Pulsations Recorded at Sodankylä during 1914–1938. E. Sucksdorff. *Terr. Mag.* 44. *pp.* 157–170, *June*, 1939.—Giant pulsations are a kind of regular sinusoidal oscillations which appear at times in magnetic and earth-current records. During 25 years there were on the average six pulsations per year at Sodankylä. These were grouped round two particular times, *viz.*, 1 h. (about 3 hr. local time) and 8 hr. G.M.T. The groups are distinguished as A and B. The pulsations of group A are the most regular and most frequent; those of group B generally last longer. Distinct maxima occur at the equinoxes, and there is a secondary maximum in summer (July). The occurrence of the pulsations appears to be connected with the cycles of solar activity, and the number per year is greater (8) during years of minimum than during years of maximum activity (4.8). Their duration varied between 10 min. and 4 hr. 25 min. The period of the pulsations ranged between 46 and 152 seconds. Although the pulsations are, as far as is known, local phenomena, the giant pulsation of April, 1938, was recorded simultaneously at six European observatories. The pulsations for the given period are tabulated in detail, their shapes are recorded, and graphs of their daily and yearly distribution are drawn. G. E. A

See also Abstracts 3595, 3826.

RADIOACTIVITY.

3606. Radioactivity of Water at Isle of Ischia. G. Imbò. *Ricerca Scientifica*, 7. *pp.* 546–551, *June*, 1939.—The radioactivity of the thermal waters in the coastal zone of the Isle of Ischia (Naples) is examined at Cetaro in the E. and at Lake Ameno in the N.E. Varying contents were found, consistent with the presence of emanation. The highest activities recorded were 28·2 and 1242 U.M. respectively. F. C. C.

3607. Synthesis of Organic Compounds containing Radioactive Sulphur. H. K. Alber. *Frank. Inst., J.* 228. *pp.* 177–181, *Aug.*, 1939.—The author has succeeded in synthesising *in vitro* two compounds containing radioactive S *viz.* : 4 : 4 -dinitrodiphenyl disulphide* and *p*-nitrobenzenesulphonyl chloride* (the asterisk is the notation for radioactivity), which are intermediates in the synthesis of the biologically important sulphanilamide. The former compound was prepared by the procedure of Hodgson and Wilson, using radioactive S and also ordinary S, and the latter by the method of Loudon and Shulman. Details of the radioactive measurements are included. H. H. Ho.

3608. Half-Periods of AcB, AcC′ and UX$_1$. B. W. Sargent. *Canad. J. of Research,* 17. *Sect. A. pp.* 103–105, *June,* 1939.—From measurements of the β-ray intensities by ionisation at different times and semi-logarithmic plots of these intensities against the time, the half-periods of AcB, AcC″, and UX$_1$ were found to be 36·1 ± 0·2 min., 4·76 ± 0·02 min., and 24·1 ± 0·2 days, respectively. AUTHOR.

3609. Half-Value Period of $^{13}_{7}$N. A. G. Ward. *Cambridge Phil. Soc., Proc.* 35. *pp.* 523–525, *July,* 1939.—As there is disagreement among the determinations of many experimenters of the half-value period of $^{13}_{7}$N a somewhat different method from usual is employed. The radio-nitrogen is enclosed in an Al block sufficiently thick to absorb all the emitted positrons, and the γ-radiation from the source is detected by a high pressure ionisation chamber. This yields a value of 9·93 ± 0·03 min. for the half-value period which is rather lower than that of previous determinations. W. E. D.

3610. β- and γ-Radiations from Cu^{64} and Eu^{152}. A. W. Tyler. *Phys. Rev.* 56. *pp.* 125–130, *July* 15, 1939.—The β- and γ-radiations from Cu^{64} and Eu^{152} have been studied with the aid of a magnetic spectrometer of high resolution. Cu emits both positrons and electrons with a maximum energy of 0·659 ± 0·003 and 0·578 ± 0·003 eMV, respectively. The effect on the shape of the spectra of scattering within the source was investigated. The spectra obtained with an extremely thin source were found to contain fewer low energy particles than those obtained with a thicker source. The thin source results in much better agreement with the original Fermi theory of β-decay than with the later modification introduced by Konopinski and Uhlenbeck. As the source is made thicker there is a gradual change in the shape of the spectra which eventually brings about better agreement with the K-U theory than with the Fermi theory. Eu emits electrons with a maximum energy of 1·885 ± 0·012 eMV and several γ-rays. The energies of three of the γ-rays have been determined as 0·123 ± 0·001, 0·163 ± 0·001 and 0·725 ± 0·003 e.M.V. AUTHOR.

3611. β-Ray Spectra of P, Na and Co. J. L. Lawson. *Phys. Rev.* 56. *pp.* 131–136, *July* 15, 1939.—The β-ray spectra of P, Na and Co have been obtained by means of a magnetic spectrometer of high resolving power. In the cases of P and Na, where the most accurate work was possible, the shapes of the spectra differ from the results previously reported by other investigators in that there are fewer low energy particles. The reduction in this number of particles has been traced to the relative absence of scattering in the radioactive source and its mounting. The general shape of the spectra is found to agree more satisfactorily with that predicted from the original theory of Fermi than that given by the modification of this theory proposed by Konopinski and Uhlenbeck. The maximum energy of the continuous electrons emitted from P and Na is found to be 1·72 and 1·4 eMV, respectively. The value for Na electrons is considerably lower than has been previously observed. The shape of the Co positron spectrum suggests two superimposed continuous distributions. The observed upper energy limit of 1·50 eMV agrees fairly well with the previously reported value. The excellent resolution of the spectrometer is illustrated by the separation of the K and L shell conversion electrons arising from a γ-ray in In. The observed resolution is only slightly less than the calculated value due to the absorption of electrons in the source. AUTHOR.

3612. U and Th Fission Produced by Fast Neutrons of Nearly Homogeneous Energy. R. Ladenburg, M. H. Kanner, H. Barschall and C. C. Van Voorhis. *Phys. Rev.* 56. *pp.* 168–170, *July* 15, 1939.—The effective cross-section of the U and Th fission for *d–d* neutrons of 2·4 eMV is determined, and the values 5×10^{-25} cm². and 1×10^{-25} cm². are found, respectively, with an uncertainty of about 25%. The ratio of the cross-sections for Th and U fission is shown to be the same within 10% for neutrons of 2·1, 2·4, 2·9 and 3·1 eMV average energy. AUTHORS.

3613. Nuclear Transformations of N with Rapid Neutrons. E. Baldinger and P. Huber. *Helv. Phys. Acta,* 12. 4. *pp.* 330–348, 1939. *In German.*—Monochromatic neutrons from the nuclear transformation $H_2 + H_2 \rightarrow He_3 + n_1$ were employed to determine the heat tone and the effective cross-section of the N(n, α)B reaction and the effective cross-section of the N(n,p)C transformation. The nuclear transformations were carried out in an ionisation chamber filled with N_2 and the carriers formed were measured by means of a linear amplifier and a strip oscillograph. An accelerating potential of 130 kV was employed in the canal ray tube used as a neutron source. For neutrons of 2·8 eMV energy the effective cross-section of the N(n, α)B transformation was found to be $\sigma = 1{\cdot}6 \times 10^{-25}$ cm². and that of the N(n, p)C process to be $\sigma = 0{\cdot}4 \times 10^{-25}$ cm². For the N(n, α)B process the measurements gave for the heat tone the value $Q = -0{\cdot}43$ eMV. Measurements for observation angles of 0° and 90° of the energy of the neutrons generated in the D(D, n)He process confirmed the hypothetical difference in the neutron energy deduced from the energy and impulse laws. A. W.

3614. Nuclear Reactions in Continuous Energy Region. N. Bohr, R. Peierls and G. Placzek. *Nature,* 144. *pp.* 200–201, *July* 29, 1939.—The typical difference between nuclear reactions in the regions of discrete and continuous level distributions of the compound nucleus is discussed. The argument developed is used to clear up an apparent difficulty as regards the order of magnitude of the cross-sections of heavy nuclei for the photo-effect with ejection of neutrons. AUTHORS.

3615. Possible Delay in Emission of Neutrons from U. D. F. Gibbs and G. P. Thomson. *Nature,* 144. *p.* 202, *July* 29, 1939.—Experiments with an intermittent source are described which show that the majority of the neutrons produced in the fission of U appear with a delay of less than 10^{-3} sec. AUTHORS.

3616. Delayed γ-Rays from U Activated by Neutrons. J. C. Mouzon and R. D. Park. *Phys. Rev.* 56. *pp.* 238–241, *Aug.* 1, 1939.—A cloud chamber in a magnetic field was operated in conjunction with a source of neutrons in such a way as to observe γ-rays emitted during the bombardment of U by neutrons and the number emitted about $\frac{1}{2}$ sec. after bombardment in alternate expansions of the chamber. Although the energy distribution of the γ-rays seems to be about the same in the two expansions, the total number of γ-rays emitted during bombardment is considerably greater than those emitted $\frac{1}{2}$ sec. after bombardment. This means that more γ-rays are obtained which are coincident (or nearly so) with fission than γ-rays associated with a period of as much as several seconds. AUTHORS.

***3617. High Intensity Bombardment with Fast Particles. F. N. D. Kurie.** *Rev. Sci. Instruments*, 10. *pp*. 199–205, *July*, 1939.—For high efficiency the target should be elementary, *i.e.*, not a compound, and the cyclotron vacuum chamber should be protected from the débris of bombardment, for which purpose the target should be isolated from the vacuum chamber. A suitable bombarding chamber is described in detail. It consists essentially of a copper box with one end closed by a water-cooled copper plate carrying the target and the other by a thin metal window; the box is filled with H_2 or He at a few mm. pressure. C. A. S.

3618. Disintegration of ZnS by α-Rays. E. Streck. *Ann. d. Physik*, 35. 1. *pp*. 58–64, *May*, 1939.—The Zn produced by disintegration by α-rays was quantitively determined by various Ra-containing ZnS-Cu phosphors and measurements made with I indicators. Light was thus thrown on the mechanism of disintegration. It may be said that the destruction by α-rays preponderantly depends on a decomposition of the basic material. Since the energy of the α-particles which are sent out in the disintegration process is known, besides the mass of Zn made free by this energy, it can be calculated that upon the decomposition of a ZnS molecule 30 eV or $1 \cdot 15 \times 10^{-18}$ cal. is consumed on the assumption that 10% of the α-ray energy escapes on the disintegration. J. J. S.

3619. Detonation of Nitrogen Iodide by Po α-Particles. M. Haïssinsky and R. J. Walen. *Comptes Rendus*, 208. *pp*. 2067–2068, *June* 26, 1939.—Exposure for a sufficient time to α-particles from Po causes nitrogen iodide to detonate, the more rapidly the greater the amount of the radiation, and the drier the iodide. The α-particles probably act by means of their heating effect. This increases as the grain size diminishes. No explosion is caused if PbN_6, AgN_3, or diazometanitraniline perchlorate is similarly acted on, though PbN_6 becomes yellow. C. A. S.

3620. α-Ray Ionisation in Gases. K. Schmieder. *Ann. d. Physik*, 35. 5. *pp*. 445–464, *July*, 1939.—The total ionisation for Po-α-particles was measured in 12 different gases and gas mixtures. Departure from an additive law was found with NO, NO_2, and N_2O; this was attributed to changes in the electronic binding energy consequent on chemical combination. It is shown that the stopping power depends essentially on the mean free path. F. C. C.

3621. Lower Limit of Continuous β-Spectrum of RaE. A. Flammersfeld. *Zeits. f. Physik*, 112. 11–12. *pp*. 727–743, 1939.—A β-ray spectrograph fitted with a Geiger-Müller counter is described with which β-rays with energy down to 5 ek V are detected. Preparations on very thin films are produced and used in an investigation of the effects of counter closure foil and source backing-layer. With RaE preparations on very thin mica foil an energy distribution curve free from all secondary effects is obtained for the range 25 to 1170 ekV and is compared with the theoretical energy distribution calculated on the theory of β-disintegration; only partial agreement is found between theory and observation. J. E. K.

3622. Recoil of Nucleus in β-Decay. H. R. Crane and J. Halpern. *Phys. Rev.* 56. *pp*. 232–237, *Aug*. 1, 1939.—Experiments on the recoil of the nucleus in the disintegration of Cl^{38} have been continued [see Abstract 2843 (1938)]. The fact that momentum is not conserved in the system consisting only of the nucleus and the emitted electron has been confirmed. By measuring the momenta of the electron and nucleus it has been possible to ascertain the direction of emission of the neutrino with respect to the direction of the electron in each case. Theoretical predictions according to both the Fermi and the K-U theory are plotted for comparison. The experimental data agree slightly better with the Fermi than with the K-U theory, but it is not safe to attach much significance to the results obtained on this aspect of the problem, because of the possibilities for rather large experimental errors. An investigation into the manner in which droplets in the cloud chamber are produced by the recoil atom has been carried out. Evidence is offered which indicates that the products resulting from dissociation of the gas molecules act as centres for condensation. This effect, in addition to ionisation, accounts for the droplets observed. AUTHORS.

3623. γ-Rays from Active Deposit of Ac. S. de Benedetti. *J. de Physique et le Radium,* 10. *pp.* 294–295, *June,* 1939.—The absorption of γ-rays from active deposit of Ac in equilibrium with its derivatives is compared experimentally with the absorption of γ-rays from AcC″ alone. Most of the γ-rays from the active deposit are attributed to the transformation AcB → AcC; a radiation of about the same energy but only one-tenth the intensity is attributed to the AcC″ → Pb transformation, as well as the soft radiation present. E. E. W.

***3624. Proportional Proton Counter. V. Kitarov and G. Schepkin.** *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 151–153, 1939. *In Russian.*—The authors describe the construction of a proportional counter to detect protons in the presence of strong γ-rays. D. S.

***3625. Operation of Counters under the Action of Radiation. G. Valle and G. Dascola.** *N. Cimento,* 16. *pp.* 59–77, *Feb.,* 1939. —A comparative study of the response of a counter to radiation inserted (*a*) in the usual circuit employing the self-capacity of the counter and (*b*) in the pentode circuit proposed by Neher and Harper [see Abstract 3804 (1936)] gives substantially the same result, *viz.,* that the limiting frequency, when the counter is irradiated strongly is a function of the constants of the circuit. The maximum frequency is limited by the blocking frequency which abolishes the effect of the counter. The low value of impedance is considerably less than the resolving power. A simple law relating the frequency of the impulses to all intensities of radiation is derived for the circuit using the self capacity of the counter; this law is not valid for the Neher-Harper circuit. It is concluded that the first type of circuit is to be preferred when the counter is used as an instrument to compare the intensities of sources of radiation, particularly radioactive substances. [See also Abstract 902 (1935).] T. A. C.

***3626. Sensitive Time of Wilson Expansion Chamber. E. J. Williams.** *Cambridge Phil. Soc., Proc.* 35. *pp.* 512–515, *July,* 1939.—Reasons are advanced for believing that the return to room-temperature of the gas in an expansion chamber, after an expansion, is governed by the heating due to a compression wave originating at the walls of the chamber. The wave is produced by conduction heating from the walls and the standard treatment for solid conduction is adapted to these conditions. The sensitive time of a chamber is found to be proportional to $(V/S)^2$ where V is the volume and S the surface area of the chamber. F. C. C.

***3627. Portable Radioactivity Meter Requiring No H.V. Battery. H. F. Kaiser.** *Rev. Sci. Instruments,* 10. *pp.* 218–219, *July,* 1939.—By using a simple valve oscillator circuit for generating the necessary high potential for operating a Geiger-Müller tube, the use of a h.v. battery can be avoided. Other advantages of the arrangement are a simplified counting rate meter, compactness, flexibility and complete portability. F. C. C.

See also Abstracts 3635, 3706, and
1894B. Constitution of Matter. R. Grégoire.

RADIATION.

ABSORPTION.

3628. Optical Properties of Thin Films of Potassium. D. Hagman. *Comptes Rendus*, 208. *pp.* 1982–1984, *June* 19, 1939.—The transmission and reflecting powers of K films are studied as a function of thickness and of the wave-length of the incident light. K shows a maximum of selective absorption between 3600 and 3800 Å at all thicknesses from 23·0 to 0·57 $m\mu$, *i.e.*, down to monatomic films, for which the maximum of reflection is 0·35%, and of absorption, 2%. The absorption increases with thickness up to 6 $m\mu$, after which it tends to be displaced towards longer wave-lengths. C. B. A.

COLORIMETRY.

3629. Series of Colours of Equal Subjective Saturation. J. Rosemann. *Zeits. f. techn. Physik*, 20. 7. *pp.* 198–203, 1939.—Klughardt and Richter [see *Zeits. f. Sinnesphysiol.* 66. *pp.* 103–136, 1935–1936] compared a colour of given colorimetric hue and saturation with a colour of slightly different colorimetric hue and variable colorimetric saturation and determined the value of the latter at which observers judged the subjective saturations of the two colours to be the same. All the colours studied had the same brightness. Proceeding in this way it was possible to determine step by step a locus of colours of equal saturation, this locus being found to be a closed curve in the colour triangle. The present author suggests that the experimental comparisons must correspond not to equal subjective saturation but to maximal similarity in the Schrödinger sense. Using Schrödinger's expression for the line element in the higher colour metric, the author shows that theoretically one would expect the locus obtained by Klughardt and Richter to be not a closed curve but a spiral. This discrepancy between theory and experiment leads to the view that a representation of the higher colour metric by a Riemannian geometry is not possible on existing principles. W. S. S.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

3630. Theory of Electric Polarisation, Electro-Optical Kerr Effect and Electric Saturation in Liquids and Solutions. A. Piekara. *Roy. Soc., Proc.* 172*A*. *pp.* 360–383, *Aug.* 23, 1939.—Recent work [see Abstract 2141 (1938)] on the theory of dielectric polarisation in polar liquids and their solutions in non-polar solvents contained the assumption of two kinds of intermolecular coupling forces. This work is now further developed, and it is shown that coupling forces of the second kind which are due, not to aggregates of well-ordered molecules (first kind), but to the next molecule which happens to be in the neighbourhood of the molecule just considered, play the more important rôle. The author first derives the general formulæ concerned and then deals with electric polarisation, the electro-optical Kerr effect, and the electric saturation effect. It is mentioned that the coupling of the second kind has proved to be also responsible for the magnitude of the magnetic birefringence in polar liquids and for its variation. These effects cannot be explained either by coupling of the first kind or by Onsager's theory. The paper is entirely mathematical. H. H. Ho.

See also **Abstracts 3664, 3771.**

EMISSION.

3631. Effect of Grain Size on Intensity of Mass Radiator. A. Kalugina. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 362–364, 1939. *In Russian.*—It is confirmed that the intensity of a mass radiator increases with the grain size. Four different grain sizes were used—cylinders from 0·9 mm. to 0·6 mm. long and 0·7 to 0·2 mm. dia. D. S.

3632. U.V. Emission during Electrolysis of Solutions of HN_3 and of NaN_3. R. Audubert and E. T. Verdier. *Comptes Rendus,* 208. *pp.* 1984–1986, *June* 19, 1939.—Light is emitted at the anode during electrolysis of solutions of HN_3 and of NaN_3, and its intensity, J, varies with the potential of the anode, V, and the current, I, according to $J = I\alpha^V$, a and α being constants. α varies with the pH of the solutions. Five bands, between 1950 and 2600 Å, are identified in each spectrum. They are close to those emitted during thermal dissociation of azides.

C. B. A.

3633. Registration of Cosmic Radiation by Coincidence Counters. H. Alfvén. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 26B. 14. [15 *pp.*], 1939. *In English.*—Coincidence counter measurements of the daily variation of cosmic rays in Stockholm have been made. The variation is of the same order of magnitude as found with ionisation chambers at Stockholm (Lindholm) as well as at other places but the amplitude is much smaller than that obtained with G.M. counters by Barnóthо and Forro and by Kolhörster [see Abstract 646 (1937).]

3634. Vertical Cosmic-Ray Intensity at Altitudes up to 24000 ft. W. F. G. Swann and W. E. Danforth. *Frank. Inst., J.* 228. *pp.* 43–61, *July,* 1939.—Measurements of vertical intensity were made using twenty Geiger-Müller " telescope " assemblies, in aeroplane flights up to 24,000 ft. The general problem of the comparison of the intensity-altitude curves given by ionisation measurements and by counter measurements is discussed in detail, and calculations are made showing how these differences depend upon the relative proportions and properties (*e.g.,* absorption coefficient and multiplicative capacity) of the hard and soft components.

D. H. F.

***3635. Correlation of Counter and Electroscope Measurements of Cosmic Radiation in the Stratosphere. S. A. Korff and W. E. Danforth.** *Frank. Inst., J.* 228. *pp.* 159–167, *Aug.,* 1939.—Comparison of several methods of measuring cosmic-ray intensities in the stratosphere is presented. Assuming the observed intensity distributions at various elevations, the relations between the vertical intensity and that measured by single counters and by electroscopes is developed. It is shown how geometry affects intensities measured with counters. The observations are found to indicate that the radiation at high elevations (0·75 m. water equivalent) is 1·1 ± 0·1 times more ionising than at lower elevations (4 m. water). This effect is due to the passage of simultaneous shower rays through the instrument, as well as single rays of higher than average specific ionisation. It is further shown that low pressure counters measure a quantity statistically proportional to that observed with electroscopes. The differences between high pressure and low pressure counters are discussed. AUTHORS.

3636. East-West Symmetry of Cosmic Radiation at Very High Elevations Near Equator and Evidence that Protons Constitute Primary Particles of Hard Component. T. H. Johnson and J. G. Barry. *Phys. Rev.* 56. *pp.* 219–226, *Aug.* 1, 1939.—The east-west symmetry of the soft component of cosmic radiation has been investigated near the equator by sending triple coincidence counters into the stratosphere with free balloons. The data were transmitted to a ground station by radio signals. Direct comparisons between eastern and western intensities were made on flights in which the orientation of the instrument was determined by means of a photo-cell actuated by light from the sun. On other flights were studied the fluctuations which would be introduced into the counting rates by the rotation of the balloon if the radiation were asymmetric. The results show that the asymmetry is less than about 7%, a value far below what would have been expected if all of the primary radiation were positive. Analysis shows that less than about 10% of the intensity at a depth of 1 m. of water is attributable to unbalanced positives. Contrasting this result with that found from the asymmetry at sea level that the mesotrons of the hard component are produced entirely by positive primaries, it becomes necessary to conclude that the mesotrons are produced in the upper atmosphere, not by the primary electrons of the soft component, but by an independent primary component consisting probably of protons or some other more massive positive ion. Reasons based upon the electrical properties of space are advanced to show that it is reasonable to expect to find protons of high energy in primary cosmic radiation. [See following Abstract.] AUTHORS.

3637. Angular Dispersion of Cosmic Radiation in Upper Atmosphere Resulting from Deflections of Low Energy Particles in Earth's Magnetic Field. T. H. Johnson. *Phys. Rev.* 56. *pp.* 226–231, *Aug.* 1, 1939.—In order to estimate the diffuseness of the soft component of the cosmic radiation with respect to the direction of the primary particles for the interpretation of east-west asymmetry measurements a calculation has been made of the angular spread of secondary rays produced by deflections in the earth's magnetic field for the idealised case where the primary particles are incident unidirectionally from the vertical. Both radiation and ionisation losses have been considered and it is found that at a depth of 1 m. of water rays whose energies exceed 15 eMV lie within 30° and half of the intensity is within 5° of the original direction. The beam broadens at higher elevations or when lower energies are included. The correction to the recent east-west asymmetry measurements at very high elevations because of this effect are wholly negligible. [See preceding Abstract.] AUTHOR.

3638. Cosmic-Ray Observations with Large Randomly-Operated Cloud Chamber. E. J. Williams. *Roy. Soc., Proc.* 162*A*.

pp. 194–212, *Aug.* 3, 1939.—An account is given of a large Wilson cloud chamber, about 30 cm. deep and 30 cm. dia. Such a chamber has a sensitive time of nearly half a second, and this, together with its large effective volume, makes it a very sensitive detector of weak radiations. The results of certain cosmic-ray observations made with this chamber are described. " Counter-control " was not used, the intrinsic efficiency of the chamber ensuring, on the average, at least one cosmic-ray track for photograph. In the absence of counter-control the photographs represent the true statistical distribution of different cosmic-ray events. Results for the energy distribution of cosmic-ray particles below 3×10^8 V are thus obtained, and also some indications of the relative frequency of showers and of slow penetrating particles (mesotrons). Certain details of earlier work by Williams and Pickup [see *Nature*, 141. *p.* 684, *April* 16, 1938] on heavily ionising tracks, which provided evidence for mesotrons, are also given in this paper. Some of the photographs taken are reproduced. AUTHOR.

3639. Cosmic-Ray Showers and Second Maximum of Rossi Curve. A. E. Ehmert. *Zeits. f. Physik*, 113. 3–4. *pp.* 234–246, 1939.—Measurements of absorption coefficients for Pb, Fe and H_2O up to great thicknesses gave results in good agreement with those of other workers. In particular it is shown that the same secondary radiation is concerned as that which was demonstrated by Maass in quite a different way and which is generated by the hard component and is responsible for the second maximum of the Rossi curve. A comparison of the absorption coefficients with the position of the second maximum shows that simultaneous production of many hard shower particles, possibly in an explosive process, cannot occur in the large majority of cases. A hypothesis is advanced which explains the connection between the absorption coefficients and the second maximum of the Rossi curve. A. W.

3640. Energy of Attraction between Luminous Bodies. C. Popovici. *Comptes Rendus*, 208. *pp.* 2052–2054, *June* 26, 1939.—It is shown that the energy expended by the mechanism of propagation of light, between two stars which attract one another according to the Newtonian law, is finite between the limits of time ± ∞. A. Hu.

3641. Emission of an Impulse Tube from 1 to 3 eMV. V. Gei, I. Piskunov and V. Saveljev. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 4. *pp.* 246–254, 1939. *In Russian.*—The radiation of a discharge tube fed from an impulse generator was studied in the range from 1 to 3 eMV, and the total radiation was found to increase as the cube of the applied impulsive potential. Filtering of the radiation produced a sharp maximum in the soft region of its spectral distribution. The spatial anisotropy of the radiation from the tube could be explained by additional absorption of indirect rays in the antikathode. An approximate calculation based on Bethe and Heitler's theory [see Abstract 3411 (1934)] is in satisfactory agreement with the experimental data. D. S.

See also Abstracts 3632, 3778.

FLUORESCENCE AND PHOSPHORESCENCE.

LUMINESCENCE AND AFTERGLOW.

3642. Fluorescence of Aqueous Solutions of Rare-Earth Salts. A. Zeidel, J. Larionov and A. Philippov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 17–24, 1939. *In Russian.*—The fluorescence of dilute solutions of Tb salts was found to be most strongly excited by light of wave-length between 2100 and 2300 Å. The spectrum consists of seven narrow bands, and is interpreted as due to transitions from the singlet term of the $4f^8$ configuration of the TbIV ion to the various components of the ground term of this configuration. This is confirmed by the coincidence of frequency of the short wave fluorescence band with one of the absorption bands of the TbIV ion. The fluorescence shows a marked after-effect. D. S.

3643. Phosphorescence of Rock-Salt Activated by Ni. I. Parfianovich. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 163–166, 1939. *In Russian.*—The momentary and prolonged phosphorescence spectra of NaCl + Ni were found to be identical consisting of one band with its maximum at 623 mμ; the absorption spectrum consists also of a single band with maximum at 246 mμ. The law of decay of phosphorescence was studied between 59° C. and 103° C. and was shown to correspond to that for a bimolecular process. The localisation energy of an electron in the lattice removed from the centre of phosphorescence was found to be 2·14 eV. D. S.

3644. U.V. Phosphorescence of X-Rayed Rock-Salt. M. Djachenko. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 307–309, 1939. *In Russian.*—The author investigated the u.v. phosphorescence spectrum excited by X-rays in irradiated rock-salt crystals and also the u.v. fluorescence spectrum excited by visible light. The results are interpreted in terms of the electronic energy levels [See Abstract 1990 (1938).] D. S.

3645. Attenuation Law of Phosphorescence of Salicylic Acid at Liquid-Air Temperature. B. Pjatnitzky. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 310–313, 1939. *In Russian.*—The decay of phosphorescence of salicylic acid was found to follow an exponential law over a large interval, and the intensity of phosphorescence was larger at lower temperature. A photoelectric method was used. D. S.

3646. Luminescent Materials. H. W. Leverenz and F. Seitz. *J. of Applied Physics,* 10. *pp.* 479–493, *July,* 1939.—A review of the properties of luminescent inorganic solids in the light of recent theories of crystals. Most of the material has already appeared [see Abstract 679 (1939)] but there are some new curves showing how the colour of emission of zinc silicate can be altered by replacement of part of the Zn by Be, by replacement of the Si by Ge and by the addition of Ti and Zr oxides to form more complex silicates. The effect of varying Mn content is also shown in a number of these cases. J. E.

3647. Zinc Silicate Phosphors. F. A. Kröger. *Physica,* 6. *pp.* 764–778, *Aug.,* 1939. *In English.*—Experiments show that in the system Zn_2SiO_4–Mn_2SiO_4 a homogeneous phase occurs with the structure of the mineral phenacite Be_2SiO_4, covering a range of 0 to 50% (mol.) of Mn. Hence it follows that zinc silicate phosphors are solid solutions of Mn_2SiO_4 in Zn_2SiO_4. The mixed crystals show at 25° C. and − 180° C. two emission bands at 5200 and 6100 Å which are attributed to transitions in the Mn^{++} ion. They also show absorption in three regions. The first, beginning in the near u.v. and rising rapidly towards 2200 Å, is the same as in pure zinc ortho-silicate, except that addition of Mn causes increase in the tail on the long-wave side; the second, occurring with 5–50% Mn, shows a rapid rise at 3000 Å but also has the characteristics of crystal absorption and the third consists of a system of narrow bands between 3000 and 6000 Å. Some other compounds of Mn and mixed crystals containing Mn have some of the same absorption bands in the visible and near u.v. Excitation takes place in three different regions—in the blue and near u.v. and coinciding with those found in absorption; in a broad band between 2200 and 3000 Å with a maximum at 2500 Å; and in an apparently unlimited range below 2200 Å. Irradiation in the second two regions produces both fluorescence and phosphorescence while irradiation in the first region produces only fluorescence. Cd silicate activated with Mn also shows excitation in a range corresponding to crystal absorption and in bands which are undoubtedly due to Mn^{++}. The fact that the crystal absorption edge in Zn_2SiO_4 and in the mixed crystals is in the same place is contrasted with the ZnS-CdS series. [See following Abstract.] J. E.

3648. Fundamental Absorption of ZnS-CdS-MnS and ZnS-MnS Mixed Crystals. F. A. Kröger. *Physica,* 6. *pp.* 779–784, *Aug.,* 1939. *In English.*—A continuation of previous work [Abstract 2053 (1939)]. ZnS has a fundamental absorption band with a long-wave limit at about 3380 Å. Introduction of MnS causes the appearance of a new band with an edge at about 3650 Å, which is identical with the fundamental absorption band of MnS. Introduction of CdS into the ZnS-MnS phosphors produces a shift of the fundamental absorption towards the red. For thin layers of ZnS-MnS mixed crystals the edge of the fundamental band for pure ZnS shifts gradually towards the red with increasing Mn but not in linear relation to the composition. It is considered that this is not a real shift of the ZnS band but is due to the appearance of the overlapping MnS band. [See preceding Abstract.] J. E.

See also Abstract 3670.

INTERFERENCE, DIFFRACTION AND SCATTERING.

***3649. Interference Fringes in Rochon's Prism. K. Asagoe.** *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 912. *pp.* 165–172, *July,* 1939.—When a light polarised partially or perfectly is passed through Rochon's double image prism from a certain end and is seen with an eye placed just behind the prism, two systems of coloured interference rings each having a neutral cross respectively are found. A theory of the interference fringes is developed and discussed. A certain type of the Rochon prism can be used as a sensitive and excellent polariscope and its sensitivity when so used is determined. AUTHOR.

3650. Action of Neophane Glass on Visibility of Interference Fringes in White Light. C. Schaefer and J. Rosemann. *Zeits. f. techn. Physik,* 20. 7. *pp.* 193–198, 1939.—When a neophane glass is inserted before the eye the fringes in an interference system obtained with white light can be observed up to much higher orders than in the absence of the neophane filter. The authors give the theory of this result and show that it comes about because the very narrow absorption band of the neophane glass at 585 mμ coincides approximately with the wave-length of maximum luminosity in the spectrum of the white light. The theory is checked by measurements with a photo-cell corrected to have a spectral sensitivity curve similar to that of the eye. W. S. S.

3651. Diffraction by Narrow Screens. V. Rogov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 346–361, 1939. *In Russian.*—The diffraction patterns of narrow screens are calculated by means of the Cornu spiral and compared with the results of direct experiment. D. S.

***3652. Microscopic Observations with Gratings having Ruling Errors. H. Siedentopf.** *Zeits. f. Physik,* 112. 11–12. *pp.* 704–726, 1939.—It is shown by reference to microscopic observations with a non-uniformly ruled 15-line glass grating with a mean constant of 15·8μ that in the vicinity of limiting resolution markedly different values may be obtained depending on the choice of optical conditions. Even greater discrepancies are shown to occur in examination and measurement of biological specimens. The results of these observations are invoked to clarify and correct misunderstandings which have arisen as to the validity of Abbe's laws when applied to conditions of limiting resolution. The special influence of edge diffraction on observations is illustrated by reference to several microphotographs. J. E. K.

See also Abstracts 3599, 3695.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

3653. Action of U.V. Light on Nitroglycerin. T. Urbanski, W. Malendowicz and R. Dybowicz. *Comptes Rendus,* 209. *pp.* 103–105, *July* 10, 1939.—Nitroglycerin, even after a short exposure to u.v. light, decomposes spontaneously, after a certain time depending on the intensity of the rays. Nitroglycerin which has been irradiated with u.v. light decomposes more rapidly on heating than if it has not been exposed to u.v. Other explosive nitro-esters behave similarly. A. J. M.

3654. Action of U.V. Radiation on Barium and Strontium Azides. W. E. Garner and J. Maggs. *Roy. Soc., Proc.* 172*A*. *pp.* 299–314, *Aug.* 23, 1939.—The threshold for the absorption of u.v. light by N_3^- ions in solution and in the solid state is 2600–2700 Å and that for the photochemical reaction is in the same region. Pre-illumination with u.v. light at room-temperature shortens the induction period of the thermal process for BaN_6 and for short times of illumination $\tau = k/t_i^8$, where t_i is the length of the induction period. Prolonged illumination with light of wave-length shorter than 2360 Å produced nuclei of metallic Ba at room-temperatures. Solarisation effects are observed in the region where nuclei are produced by the action of u.v. light. The thermal decomposition of BaN_6 is unaffected by a field of 1250 V/cm. The general features of the reaction kinetics of the photochemical reaction are discussed. [See following Abstract.] AUTHOR.

3655. Thermal Decomposition of Crystals of Barium Azide. A. Wischin. *Roy. Soc., Proc.* 172*A*. *pp.* 314–325, *Aug.* 23, 1939.—The nuclei formed in the decomposition of barium azide increase in radius at a linear rate and increase in number as the 3rd power of the time. The activation energy for nuclear growth has been shown to be 23·5 kg.cal., and that for nuclei formation 74 kg.cal. approximately. The frequency of activation in the case of nuclei growth is 10^{14}. [See preceding and following Abstracts.] AUTHOR.

3656. Decomposition of Metallic Azides. N. F. Mott. *Roy. Soc., Proc.* 172*A*. *pp.* 325–334, *Aug.* 23, 1939.—A theoretical discussion of the decomposition of metallic azides, based on the Wagner-Schottky theory of ionic conductivity and the electron theory of solids. The main points discussed are: the formation of metallic nuclei and the nature of the induction period; the way in which the presence of nuclei catalyses the reaction; the action of ultra-violet light. The similarity between the decomposition of azides and the photochemical reduction of silver halides is pointed out. [See preceding Abstract.] AUTHOR.

3657. Luminescence of CN Radical Due to Photodissociation of CN Molecules. A. Jakovleva. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 302–306, 1939. *In Russian.*—It is found that irradiation of CN with Schumann rays causes photodissociation with emission of the violet band of the CN radical. The rotational energy of the CN radical in these circumstances is found to correspond to 1500° K. The effect on the luminescence of collisions with foreign molecules (A, N_2 and CO) is also studied. [See Abstract 1632 (1939).] D. S.

3658. Mechanism of Development. Part I. T. H. James. *Kodak Research Lab., Comm. No.* 707. *J. Phys. Chem.* 43. *pp.* 701–719, *June*, 1939.—Experimentally examines the general effect of oxidation products on the development process, and the nature of the induction period. The results obtained in the absence of O_2 show that the presence of an induction period appears only if the developing agents possess a negative charge on the active ion; the greater the negative charge the longer is the induction period. This may be explained on the assumption that an ion must penetrate a potential barrier due to adsorbed halide ions before it can effect reduction, thus implying that the chemical reaction must take place at or very near the surface of the grain. Oxidation products may act either to increase or decrease the rate of development, an increase being observed with divalent ions, and the decrease if the ions are monovalent or with neutral molecules. Finally the decrease in development rate due to oxidation products is especially pronounced among the members of the p-phenylenediamine series. R. C. F.

3659. Experiments on Nature of Graininess. E. W. H. Selwyn. *Kodak Research Lab., Comm. No.* H717. *Phot. J.* 79. *pp.* 513–524, *Aug.*, 1939.—Experiments have been made relating to the number distribution of the silver particles, and the distribution of density in developed photographic materials. The number distribution is that expected from theoretical calculations, but the density distribution observed appears to be a resultant of two types of variation. One of these is relatively quick and in agreement with the results of calculations based on the assumption that the densities of neighbouring areas are independent. The second variation is much slower, and is attributed tentatively to scattering of light in the developed layer, as a result of which some degree of correlation is to be expected between the densities of neighbouring areas. The apparatus and methods of obtaining the results are described in detail. [See Abstract 162 (1936).] AUTHOR.

3660. Viewing of Solid Pictures without Binocular Apparatus. O. Bender. *Phot. Indust.* 37. *pp.* 650–653, *May* 31; 680 *and* 682, *June* 7; 703–704, *June* 14, *and pp.* 730–732, *June* 21, 1939.—Deals briefly with the various methods, as published in patent specifications, for the obtaining of stereoscopic effects without binocular viewing apparatus. Parallax stereograms, in which the two pictures are produced with alternate dense and transparent narrow bands on them, are principally discussed, modifications in the methods to allow of more than two pictures being taken simultaneously being also described. R. C. F.

See also Abstracts 3632, 3668.

PHOTOMETRY.

3661. Fundamental Theorem in Photometry of Optical Systems. P. Satche. *Rev. d'Optique*, 18. *pp.* 20–32, *Jan.*, 1939.—Discusses the fundamental theorem which relates the angular flux density in any portion of a medium of varying refractive index with the density in any other portion. This relation, due to Clausius, is $n^2 ds \cos\theta \, d\omega = n'^2 ds' \cos\theta' \, d\omega'$ where n is the refractive index of the medium at the position in which ds, an element of area, is situated, θ is the angle of incidence on (or emission from) ds and $d\omega$ is the angle of the cone in which the flux is emitted or received. The author gives a formal demonstration of the theorem in its most general form. J. W. T. W.

POLARISATION.

3662. Rotatory Power of Tannin. G. Lovera. *Accad. Sci. Torino, Atti*, 74. *Disp.* 3*a*. *pp.* 244–249, *Jan.–March*, 1939.—Results are given of measurements with the polarimeter of the rotatory power of solutions of tannin in water and acetone, and a possible explanation is suggested of the anomalies which are found to occur. J. J. S.

***3663. Brace Half-Shadow Method. Y. Björnståhl.** *Phys. Zeits.* 42. *pp.* 437–443, *July* 1, 1939.—From a method of Poincaré, expressions are deduced for the cases when the half-shadow arrangement is placed between polarising prism and compensator plate and also between compensator and analysing plates. Contrary to the theory given in the textbook of Kohlrausch, different formulæ are arrived at in the two cases. F. S.

3664. Optical Activity and Magneto-Optical Activity of Crystalline Nickel Sulphate in the Near Ultra-Violet. F. G. Slack and P. Rudnick. *Phil. Mag.* 28. *pp.* 241–247, *Aug.*, 1939.—Crystals of the hexahydrate cut along the cleavage plane (001) were used. The same method [see Abstract 4107 (1938)] was employed, a quartz spectrograph replacing the glass prism instrument. The rotation α in degrees per mm. is given by $\alpha = 0{\cdot}718/(\lambda^2 - 0{\cdot}0244) + 1{\cdot}834/(\lambda^2 - 0{\cdot}8156) + 0{\cdot}0104/(\lambda^2 - 0{\cdot}1482)$, and the magnetic rotatory dispersion δ by $n_\lambda \delta_\lambda = 0{\cdot}01025\lambda^2/[\lambda^2 - (0{\cdot}135)^2]^2$ where n_λ is the refractive index. S. J. G.

See also Abstract 3649.

REFLECTION, REFRACTION AND DISPERSION.

3665. Determination of Foci and Principal Points. F. Staeble. *Zeits. f. Instrumentenk.* 59. *pp.* 271–272, *July*, 1939.—A further development of formulæ set out in a preceding paper. [See Abstract 3279 (1939).] C. B. A.

3666. Dispersion and Transmission of Lucite. A. H. Pfund. *J.O.S.A.* 29. *pp.* 291–293, *July*, 1939.—A study is made of the dispersion and transmission in the u.v., visible and near infra-red regions of Lucite (methyl methacrylate polymer), a substance which—because of its remarkable clarity—may become useful as an optical medium. A. H.

***3667. Measurements and Tests of Accuracy with the Leeman-Kern Graphometer. F. Löschner.** *Zeits. f. Instrumentenk.* 59. *pp.* 191–199, *May, and pp.* 221–233, *June*, 1939.—The results of a series of tests with the instrument described earlier [see Abstract 1633 (1938)] are communicated. These comprise the results of measurements for distance and height with various elevations. The systematic and accidental errors which arise are discussed. The tests show that the new kind of diagram, symmetrical about the initial cross-mark for the distance-height curves, is throughout quite valid and possesses distinct advantages. The systematic errors can be dealt with by using correction tables. R. S. R.

***3668. " Ultraphot " Photomicrographic Apparatus. K. John.** *Zeits. f. Instrumentenk.* 59. *pp.* 273–280, *July,* 1939.—The " Ultraphot," the universal photomicrographic arrangement as made by Zeiss is described in detail. It is pointed out that other makes have been studied with a view to incorporating as many features as possible. Many uses are claimed for it. F. S.

See also Abstracts 3487, 3628.

SPECTROSCOPY.

***3669. Standard Slide for Qualitative Spectrum Analysis. T. C. Chang.** *J. Shanghai Sci. Inst. Sect.* 1. 1. *pp.* 225–238, *May,* 1939. *In English.*—The slide consists of an enlargement of the spectrum of R.U. powder in the carbon arc. The enlargement is marked with five groups of wave-lengths—those due to Fe and Cu standards, the most sensitive lines of rare elements, the ordinarily persistent lines of rare elements and the corresponding groups of lines of other elements. F. S.

3670. Approximate Estimation of Benzopyrene Content of Tar. A. Kling and M. Heros. *Comptes Rendus,* 208. *pp.* 2075–2077, *June* 26, 1939.—A solution of benzopyrene (and foreign substance) is obtained by treating tar with petrol ether. The solution is partly purified by treatment with K and by aqueous H_2SO_4. Its fluorescent spectrum contains 4 characteristic bands at 4040, 4095, 4180, and 4270 Å. On progressive dilution of the solution the opacity of these bands diminishes and they become gradually finer. At a certain dilution the only bands visible are the ultimate bands 4040 and 4270 Å. To this diluted solution are added increasing amounts of benzopyrene and the fluorescence spectra are photographed, as well as that of a petrol ether solution of pure benzopyrene of known strength. Using a Chalonge microphotometer the opacity of the maximum 4270 Å is measured for each diluted solution (*a*, *b*, *c*, etc.) and for the standard solution (*T*). The plot of $R_a(_{b,c,\text{etc.}})$ = opacity of the 4270 Å maximum for solution *a* (*b*, *c*, etc.)/opacity of this maximum for solution *T* gives a curve from which the approximate content of benzopyrene in the tar is estimated. W. R. A.

3671. Quantitative Spectrum Analysis of Metallic Solutions. P. Jolibois and R. Bossuet. *Comptes Rendus,* 209. *pp.* 91–93, *July* 10, 1939.—The minimum concentrations are determined of 21 metallic ions which in a *N*-solution of NH_4Cl give the persistent spectrum (*raies ultimes*) in 5 min. exposure with a current of 40 mA. They vary from *N*/31800 for Au, Pd and Cd to *N*/135 for Li. The spectra thus obtained contain but few lines. The method is not applicable to non-metals, rare-earth metals or Nb, Ta and some others. [See Abstract 2668 (1937).] C. A. S.

3672. Vacuum Wave-Length Measurements in Fe Spectrum by Reflection Echelon Graging. W. E. Williams and A. Middleton. *Roy. Soc., Proc.* 172*A*. *pp.* 159–172, *Aug.* 3, 1939.—The vacuum wave-lengths of 47 Fe lines have been determined directly against the red Cd standard by a new method employing a reflection echelon *in vacuo* so that no corrections for the refractive index of normal air need be made. By using a Schüler type hollow-kathode source, much narrower lines are obtained than is possible with an iron arc, and the concordance of independent determinations justify the values being given to 8 significant figures. The work is being extended further to the u.v. AUTHORS.

3673. Regularities in Third Spectrum of Thorium. R. J. Lang. *Phys. Rev.* 56. *pp.* 272–274, *Aug.* 1, 1939.—The Th spectrum is very rich in lines and extends into the far u.v. beyond 200 Å. The lines have been classified into II, III and IV as far as 1500 Å by means of the pole effect. A condensed spark in air and in N_2 between metallic electrodes was used. The Th III spectrum lies on the short side of 3500 Å with most of its strong lines between 3000 and 2200 Å. 24 energy levels are given. AUTHOR.

3674. Visible Absorption Spectrum of Bichromate Ions at 20° K. J. Teltow. *Zeits. f. phys. Chem.* 43. *Abt. B.* 5. *pp.* 375–383, 1939.—The visible absorption spectrum of Cr_2O_7 ions, observed with thin layers (0·19 and 0·53 mm.) of $K_2Cr_2O_7$ at 20° K, contains about 20 sharp and 30 diffuse lines between 18165 and 19190 cm^{-1}., and a continuum gradually increasing in intensity towards higher frequencies. Increase of temperature causes the intensity and definition of the lines to decrease rapidly, and at 60° K. they cannot be observed. The sharp lines are interpreted as pure electronic transitions, which are split extensively as a result of asymmetric crystal fields and the complicated nature of the Cr_2O_7 radicals. The diffuse lines, the continuum, and the temperature dependence of the lines are a consequence of lattice vibration. [See Abstract 3310 (1939).] W. R. A.

3675. Broadening and Displacement of Spectral Lines. P. Budini. *N. Cimento,* 16. *pp.* 86–107, *Feb.,* 1939.—A review of the theory of the width and displacement of spectral lines, in extension of former work [see Abstract 680 (1936)]. The first section of the present paper deals with the width of the spectral lines arising from unperturbed atoms, natural spectral width and Doppler width; the second section deals with the width of spectral lines arising from atomic and molecular perturbations. The first- and second-order Stark effects are considered as well as the theory of van der Waals interactions. The general theory and emission of resonance perturbations is developed and compared with experiment. [See also Abstract 2885 (1938).] T. A. C.

3676. Broadening and Displacement of Mean and High Series Lines of K by He of High Pressure. C. Füchtbauer and W. v. Heesen. *Zeits. f. Physik,* 113. 5–6. *pp.* 323–333, 1939.—For the 8 K lines 1*s*–5*p* to 1*s*–12*p* the displacement and the line breadth were measured as dependent on the density of the disturbing gas (He) up to high relative densities. For 1*s*–4*p* only the line breadth was measured. The displacement was found in all cases to be accurately proportional to the relative density, certainly for the highest series lines investigated. This result raises doubts as to the validity of that part of Fermi's theory concerned with the influence of the dielectric constant of the disturbing gas. As regards the broadening, for all the densities investigated the maximal breadth of the line 1*s*–4*p* was reached. For the high series members the breadth tends towards a constant and moderately small value, but falls away from the maximum value much quicker with high than with low relative densities of the disturbing gas. In the case of the line 1*s*–5*p*, for high relative densities the breadth was found to increase less than for lower relative densities, the curve being slightly concave viewed from below. A. W.

3677. Hyperfine Structure of Spectral Lines. H. C. Burger and P. H. van Cittert. *Ned. T. Natuurk.* 6. 10. *pp.* 169–181, 1939.—Short summary of known facts about hyperfine structure and nuclear moments. R. P.

3678. Nuclear Magnetic Moments of B Isotopes. S. Millman, P. Kusch and I. I. Rabi. *Phys. Rev.* 56. *pp.* 165–167, *July* 15, 1939.—The nuclear Landé *g* values of ${}_5B^{10}$ and ${}_5B^{11}$ have been measured by means of the molecular beam magnetic resonance method, with the alkali tetraborates and metaborates. The values which were found are, in units of *e/2Mc*, 0·597 ± 0·003 and 1·788 ± 0·005. The assignment of the observed *g* values to the appropriate isotopes is discussed with the result that the former is assigned to B^{10} and the latter to B^{11}. If values of 1 and $\frac{3}{2}$ be assumed for the nuclear spins of B^{10} and B^{11}, respectively, the magnetic moments are 0·597 ± 0·003 and 2·682 ± 0·008 nuclear magnetons for the B^{10} and B^{11} isotopes, respectively. [See Abstract 2090 (1939).]

AUTHORS.

3679. Absorption Spectra of Thiophene and its Homologues. P. Barchewitz and J. Garach. *Comptes Rendus*, 208. *pp*. 2071–2072, *June* 26, 1939.—The absorption spectra of thiophene, α- and β-methyl thiophenes, and α·α′-, α·β-, and α·β′-dimethyl thiophenes have been observed from 0·6 to 1·0μ. The spectrum of thiophene contains the third and fourth harmonics of the fundamental (CH) band; each is distinguished by two distinctive bands situated at 8665 and 8594 Å (third harmonic), 7087 and 6995 Å (fourth harmonic). No band is found at 9700 Å, indicating that the near infra-red provides no evidence for ethylenic double bonds in the thiophene molecule. α-methyl substitution causes the diminution in intensity of the (CH) band the most displaced towards short wave-lengths; α·α′-dimethyl substitution causes this band to disappear. With β-methyl substitution, however, the long wave-length (CH) band decreases in intensity, and finally disappears with β·β′-dimethyl substitution. In addition, substitution causes a general displacement of bands which increases with the degree of substitution. The absorption spectrum of thionaphthene contains the benzene (CH) band at 8786, and the thiophenic (CH) bands at 8623 and 8700 (?) Å. In the more complex allyl sulphide spectrum, bands characteristic of (CH =), (CH_2 =), and (CH_2) are found, and a band at 9704 Å due to a double bond in the molecule. This band is not observed in the spectra of thiophene and its homologues. The positions of the principal bands are 9704 (C = C), 9170 (CH_2), 8773 doublet (CH_2 =), and 8546 Å (CH =). The interpretation of the spectra is considered. The displacement to short wave-lengths of the two bands of each harmonic for thiophene, relative to their positions in benzene may be due to strains in the 5-membered ring, or to the unsaturated state of the thiophene molecule. The necessity of distinguishing between the (CH_α) and (CH_β) bands, due respectively to (CH) vibrators in the α- and β-positions, for the interpretation of the spectra of thiophene homologues is indicated. W. R. A.

3680. Infra-Red Absorption of Tetra-Deuteroethylene. G. K. T. Conn and G. B. B. M. Sutherland. *Roy. Soc., Proc.* 172*A*. *pp*. 172–193, *Aug*. 3, 1939.—This work was carried out in order to throw light on the closely related spectrum of ethylene, the absorption spectrum of tetra-deuteroethylene being examined over the range 1·0–19·0μ. The results of both the low and high resolution examination are given in detail. These results are then discussed at length, with particular reference to the ethylene spectrum. The main conclusion drawn from the work is that the fundamental frequencies of ethylene are not yet definitely settled, and that all the current assignments are wrong. A. H.

3681. Infra-Red Absorption Spectrum of Gaseous and Liquid SO_3. H. Gerding and J. Lecomte. *Physica*, 6. *pp*. 737–763, *Aug*., 1939. *In German*.—Details are given of the arrangements used for obtaining the absorption spectrum of the highly reactive substance SO_3 in the rock-salt and KCl regions (7μ to 20μ). The principal result for the gaseous state is that the molecule possesses a symmetrical plane configuration of symmetry D_{3h}. The associated frequencies are 653, 1068, 1332 and probably 530 cm^{-1}. The matter is considerably more complicated for the liquid, a number of different kinds of molecules being associated together. Further, the results for the liquid indicate with certainty that a considerable number of the liquid molecules are affected by interaction forces. The symmetry of the molecule groups differs appreciably from that of the gaseous molecules. The associated frequencies of the liquid are probably 530, 653, 1068 and 1378–1402 cm^{-1}. A comparison with the ionic radicals CO_3 and NO_3 in crystals strengthens the probability of the suggested symmetry. It is considered that the data lead to the conclusion that the principal polymer is a ring of three molecules possessing the symmetry C_{3v}. J. E.

3682. Temperature Parameters from Negative Bands of N_2 under Excitation by Electron Impact. O. S. Duffendack and Kuang-Tseng Chao. *Phys. Rev.* 56. *pp.* 176–184, *July* 15, 1939.—In a field-free space, temperature determinations along the axis of the discharge tube were carried out from measurements of band intensity distributions under different excitation conditions. A theoretical formula is derived in terms of Bessel functions giving good agreement with experiment. The change of thermal conductivity of the gas was found to account for the variation of temperature with gas pressure. The temperature variation with current under different positions of the tube is ascribed to the effect of convection currents. The indicated temperature was shown to be independent of the accelerating potentials from 20 to 800 V. The non-transference of energy between electrons and molecular rotation is attributed to the large difference of the masses of the electrons and N_2 molecules. In an investigation of the temperature distribution between the electrodes in a l.v. arc. the ready transfer to the gas molecules of the energy of the positive ions, which increases with the field, explains the observed temperature increase with potential applied to the arc. When the negative bands are excited by collisions of the second kind it is concluded that some of the surplus energy goes into molecular rotation during collisions. In a cold kathode glow discharge, gas temperatures and electron temperatures were found to be higher near the kathode fall space. N. M. B.

3683. Absorption Spectra of Organic Compounds and Nature of Unsaturated Linkages. A. Burawoy. *Chem. Soc., J. pp.* 1177–1188, *July*, 1939.—Visible and u.v. absorption bands of organic compounds are divided into two classes, *viz.*, (i) R-bands, due to R-chromophores, *e.g.*, multiple linkages in a radical state, and unsaturated atoms of free radicals; and (ii) K-bands, due to K-chromophores, *e.g.*, conjugated systems. Organic compounds containing multiple linkages represent equilibria between molecules of the same atomic but different electronic structure. Various types are discussed and absorption spectrum data, with curves, are recorded for a large number of aromatic and some aliphatic compounds. C. B. A.

3684. Absorption Spectra and Structure of Compounds Containing Chains of Benzene Nuclei. A. E. Gillam and D. H. Hey. *Chem. Soc., J. pp.* 1170–1177, *July*, 1939.—The general failure of chemical tests to disclose the existence of conjugation between the two aryl nuclei in diphenyl and its derivatives suggested that the internuclear link was an invariable single bond uniting two independent *cyclo*hexatrienoid systems.

Evidence from dipole measurements, however, indicated that this independence was by no means complete, a view which was supported by the results of the X-ray analysis of diphenyl and related compounds. The latter results indicate that the internuclear bond is hybrid in type and assumes some measure of double-bond character. The existence of such internuclear conjugation is now confirmed by an examination of the absorption spectra of diphenyl, *p*-terphenyl, *p*-quaterphenyl, *p*-quinquiphenyl and *p*-sexiphenyl, which reveals a progressive displacement of the main absorption band towards longer wave-lengths together with an increase in intensity as the chain of benzene nuclei is lengthened at the *para*-positions. On the other hand in the *meta*-series the absorption spectra of *m*-terphenyl and of hydrocarbons containing from nine to sixteen benzene nuclei united at the *meta*-positions exhibit one band at approximately 2530 Å (in chloroform) for the whole series, with a progressive increase in intensity as the chain is lengthened. These results indicate that, although in the *para*-series there is a measure of conjugation throughout the molecule as a whole, yet in the *meta*-series, where the structure does not permit simple conjugation to extend beyond two benzene units, the conjugation responsible for the absorption is that inherent in two benzene nuclei as in diphenyl itself. Evidence is put forward which indicates that the chromophoric unit in both series of hydrocarbons is half a diphenyl molecule as distinct from a benzene molecule. AUTHORS.

3685. Absorption Spectrum of NOCl. C. F. Goodeve and S. Katz. *Roy. Soc., Proc.* 172*A. pp.* 432–444, *Aug.* 23, 1939.—The extinction coefficient curve of NOCl has been measured in the visible and u.v. and 11 bands have been observed. Four of these in the u.v. and blue have been attributed to transitions to upper potential energy curves of the repulsion type. The remaining bands in the green and yellow are of the type found for transitions to vibration levels in a stable or partly stable excited state. This excited state appears to arise from a hitherto unknown level of the NO molecule. These latter bands showed no fine structure and were nearly symmetrical. A tentative assignment which is in accordance with all the observations, including studies of the effect of temperature, has been put forward. AUTHORS.

3686. Assignment of Electronic Bands in Spectra of Solutions. Part II. G. Kortüm. *Zeits. f. phys. Chem.* 43. *Abt.B.* 4. *pp.* 271–291, 1939.—It is possible to compute the lowest excitation energy, *i.e.*, the absorption bond of lowest frequency of aromatic compounds in simple cases by forming an eigenfunction of the whole molecule through superimposed fictitious eigenfunctions of the *p*-electrons [see Abstract 1217 (1939)]. The excitation energy decreases with the number of conjugated double bonds, *i.e.*, with an increasing *p*-electron system. The very weak absorption of the nitro-group in aromatic molecules leads to the interpretation that the spectra of aromatic nitro-compounds are due to an interaction of the free electron-pairs of the nitro-group with the *p*-electron of the benzene-molecule. It is not possible to decide definitely in the case of the aromatic nitro-compounds whether the observed bands can be assigned to separate chromophores. Measurements of the absorption bands of a number of simple aliphatic nitro-compounds and oximes show that a definite electronic structure is predominant in these molecules so that it seems possible to assign certain absorption bands to certain characteristic substituent groups. L. K.

3687. Potential Function of Halogen Derivatives of Ethane and Ethylene. A. Verleysen. *Ann. Soc. Sci. des Bruxelles,* 59. *pp.* 267–284, 1939.—The potential function of the molecules BrH_2C-CH_2Br and of 1,2-*trans*-$C_2H_4Br_2$ has been computed under the assumption that the H atoms are rigidly bound to the C atoms. The potential functions obtained can be used for the calculation of the vibration frequencies of similar compounds in which a certain number of H atoms has been replaced by D. In the same way the potential functions of the Cl derivatives of C_2H_4 have been worked out. The resulting force constants show that the rigidity of the C-C linkage is diminished with an increasing number of atoms X present in the molecule while at the same time the valence force C-X and the force maintaining the angle C-C-X are increased. The position of the halogen atoms in the molecule is likewise important. If they are in position 1,1 the valence force and the angular force are greater than for the cases 1,2 *cis* or *trans.* In the latter case, it is necessary to introduce into the potential function terms for the interaction between the C-C linkage and the C-X linkage and the angle C-C-X. Finally, the potential function and the normal modes of vibration of C_2Cl_4 are given. The fundamental vibrations of this molecule can no longer be separated into valence and deformation vibrations as in the case of C_2H_4. L. K.

3688. Vibration-Rotation Energies of Nonlinear Triatomic XY_2 Type of Molecule. W. H. Shaffer and H. H. Nielsen. *Phys. Rev.* 56. *pp.* 188–202, *July* 15, 1939.—The problem of the vibration-rotation energies of the nonlinear triatomic molecule of the XY_2 type and their dependence upon the constants occurring in the potential energy function has been considered in the quantum mechanics. The quantum-mechanical equation has been derived in a perfectly general manner and contains all interaction terms between rotation and oscillation and all anharmonic potential energy terms to a second degree of approximation. The approximate eigenvalues of the Schrödinger equation have been calculated by means of the nondegenerate perturbation theory of quantum mechanics and it is found that the energy may be expressed essentially as that of the molecule oscillating anharmonically and that of a semi-rigid rotator where the moments of inertia are no longer strictly speaking constants, but quantities depending to some extent also upon the vibration quantum numbers and the potential energy constants. Expressions for the effective moments of inertia and the coefficients of the centrifugal expansion terms are evaluated and given in explicit form. AUTHORS.

3689. 7·4μ Fundamental Vibration of Methyl Chloride. A. H. Nielsen and H. H. Nielsen. *Phys. Rev.* 56. *pp.* 274–276, *Aug.* 1, 1939.—A new and fairly successful attempt has been made to resolve the fundamental vibration-rotation band ν_3 of methyl chloride with the aid of a prism-grating spectrometer. The rotational line spacing averaged over the P and R branches was found to be $1 \cdot 15$ cm^{-1}. From this value the moment of inertia *A* was calculated as $48 \cdot 0 \times 10^{-40}$ gm.cm^2. The Q branch of this band has a satellite at a separation of about $1 \cdot 0$ cm^{-1}. towards lower frequencies. This line is taken to be the Q branch for ν_3 in CH_3Cl^{37} since it agrees very well with the calculated position of this band when valence forces are assumed. AUTHORS.

3690. Continuous U.V. Spectrum of Na. J. Bott. *Ann. d. Physik,* 35. 4. *pp.* 314–328, *June,* 1939.—The principal series is followed by continuous absorption which is connected with an ionisation of the atoms. The continuous absorption of Na vapour has been measured photographically between 2800 and 2100 Å. The observed values of the absorption coefficient show good agreement with theoretical computations. The atomic absorption coefficient was found to be $k = 2{\cdot}5 \times 10^{-19}$ for 2400 Å. It is proportional to λ^8. The number of dispersion electrons for the entire continuum is $f_{cont.} = 0{\cdot}0018$. An attempt was made to measure the photoionisation by a space-charge method. For this purpose the author investigated the electron emission from a tungsten kathode covered with Na. The W-Na surface was found to have a work function of 2·8 eV. The photo-effect could not be measured as the space-charge method fails for a low electron emission. L. K.

3691. Effect of Foreign Gases on Continuous Absorption Spectrum of Br_2. N. S. Bayliss and A. L. G. Rees. *Faraday Soc., Trans.* 35. *pp.* 792–800, *July*, 1939.—Foreign gases at about 60 cm. pressure increase the intensity of the visible absorption continuum of Br_2 in the following order: N_2, O_2, He, HBr, CO_2, HCl, Ne. N_2 and O_2 have the smallest effect (about a 10% increase), while HCl and Ne increase the intensity by over 25%. The effect varies linearly with the partial pressure of the foreign gas, and, except in the cases of He and Ne, it seems to be related to the molecular polarisation of the foreign gas molecules, and to the Rabinowitch coefficients for the recombination of Br atoms in the presence of foreign gases. There is no appreciable displacement of the maximum. The weak u.v. absorption of Br_2 is enhanced markedly by foreign gases. The effect is complicated by the failure of Beer's law in this region, and by the apparent necessity for the existence of three electronic transitions to account for the observations. AUTHORS.

3692. Fluorescence and Absorption Spectra of Complex Molecules. D. Blokhintzev. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 4. *pp.* 459–466, 1939. *In Russian.*—The author discusses the relationship between absorption and fluorescence spectra of molecules which contain a large number of atoms. He finds that there should be a law of " mirror images " over a frequency interval $\bar{E}/h$ where $\bar{E}$ is the mean energy of the molecule at double the temperature. D. S.

3693. Stark Effect of Balmer Lines after Passage of Atoms through Very Strong Electric Field. R. Ritschl. *Phys. Zeits.* 40. *pp.* 413–415, *June* 15, 1939.—Experimental observations are reported which show that when a H canal ray traverses such a high transverse electrical field that the red-displaced Stark components of a particular H line disappear by ionisation there appear only violet-displaced components of the line when the field along the ray is decreased in intensity. If the ray traverses a second condenser with reversed field direction only violet-displaced components have enhanced intensity but for a part of the canal ray the intensity crosses over to the red-displaced components ; this part is assumed to comprise atoms which have passed exactly through the plane of symmetry of the field and have retained their orientation. If after traversing a strongly ionising field the canal ray traverses a field-free space then on subsequent increase of the field it is again only the violet-displaced components which appear. J. E. K.

3694. Raman Spectra and Structure of Amides. C. Sannié and V. Poremski. *Comptes Rendus*, 208. *pp.* 2073–2075, *June* 26, 1939.—The Raman spectra of acetamide, mono- and di-ethyl acetamide, and ethyl imino-ether have been obtained in the pure state and in solutions of water, HCl, dioxane, etc. Change of solvent has an effect only on the Raman bands of frequency 1500 to 1750 cm^{-1}. The number of bands attributable to double linkings of the type C : O and C : N indicate that the forms in which amides can exist are more than those indicated by chemical properties, *i.e.*, imino-alcohol and true amide. In non-polar solvents and in the pure state the amide takes up the resonance form suggested by infra-red and dipole measurements, *i.e.*, $CH_3\cdot C(OH){:}NH \rightarrow CH_3\cdot C(\bar{O}){:}\overset{+}{N}H_2$. The latter excited form can easily pass into the true amide. The problem is complicated by association which changes with the solvent. Association does not, however, change the position of the (C:N) band. The Raman bands characteristic of the different forms are recorded. Ethyl imino-ether is characterised by a sharp intense band at 1653 cm^{-1}., which, contrary to the amides, is not appreciably displaced with change of solvent. W. R. A.

See also Abstracts **3641**, **3647**, **3648**, **3657**, **3712**.

TRANSMISSION.

3695. Search for Electrostatic Analogue to Gravitational Red Shift. H. T. Drill. *Phys. Rev.* 56. *pp.* 184–185, *July* 15, 1939.—The possibility of an effect of electrostatic difference of potential upon the frequency of light, analogous to the gravitational red shift, has been investigated. Light of wave-length 5461 Å was made to pass from a region of alternately zero, 300 kV positive, and 300 kV negative potential, established by means of a van de Graaff generator, to a sensitive interferometer *in vacuo* at zero potential, where a frequency shift was sought. The results indicate a shift of about 0·9 ± 1·0 part in 10^{15} per volt, which is interpreted as a definite null result. [See Abstract 1532 (1932).] AUTHOR.

3696. Generalised Formula for Doppler Effect. L. Fleischmann. *J.O.S.A.* 29. *pp.* 302–304, *July*, 1939.—The formula for the Doppler effect is worked out for the case when source and observer are both moving in any manner in flat space. The change in frequency when the source is moving along a straight line with constant velocity relative to a fixed observer, and passes at a given minimum distance from the latter is worked out and it is shown that there is no finite jump of frequency as the point of minimum distance is passed through. Moreover the change of frequency is not the same as that found on the assumption that the source is at rest and the observer is moving along a straight line passing at a given minimum distance from the source. The case of motion of the observer under gravity relative to a fixed source is also worked out in detail. G. C. McV.

3697. Propagation of Light in Inhomogeneous Media. P. H. van Cittert. *Physica*, 6. *pp.* 840–848, *Aug.*, 1939. *In English.*—A system of simultaneous differential equations is derived, which give the connection between the incident and the reflected wave in a medium, which is inhomogeneous in one direction only. These equations are solved for the case of reflection in very thin layers and for the case of thick layers with slowly variable refractive index. Contrary to the results of Gans [see Abstract 53 (1916)] it is shown that no distinct total reflection appears, but that the waves follow Snellius' laws everywhere. AUTHOR.

See also Abstract **3666**.

VISION.

See Abstracts **3629**, **3697**.

X-RAYS.

3698. Heat Transmission through Anode of X-Ray Tube. K. H. P. Nieukerke. *Physica*, 6. *pp.* 721–727, *Aug.*, 1939. *In English.*—

A solution is given for the temperature field in a water-cooled half cylindrical anode with line focus. This kind of anode gives a better heat transmission than an anode with a flat cooled wall. AUTHOR.

3699. Influence of Laminar and Turbulent Flow on X-Ray Diffraction Patterns of Water and Nitrobenzol. W. Dubs. *Helv. Phys. Acta,* 12. 3. *pp.* 169–228, 1939. *In German.*—It is established by X-ray investigation of water and nitrobenzol whether the hydrodynamic effect of transition from laminar to turbulent flow continues to operate for molecular orders of magnitude and eventually leads to an action on cybotactic molecular group arrangement [see Abstract 1931 (1931)] or to quasi-crystalline structure of the liquid. For explanation of such an influence clearly determined flow conditions must be furnished. These were established visually by colour mixtures and also by measurement based on Reynolds' theory. Amongst kinematographic pictures with gradually enhanced Reynolds numbers there could be obtained separate phases of the whirlpool formation especially in the transition region with various degrees of turbulence. For the accessory values of resistance a good agreement was got with the laws of Poiseuille and Blasius. The liquids were then examined under known flow conditions by the Debye-Scherrer method. The measurements made on water and nitrobenzol show only very small differences. It was found with certainty that in the X-ray diagram a greater effect does not exist than change of the flow form clearly indicated. J. J. S.

3700. Correlation and Scattering of X-Rays in Solid Solutions. I. Lifshitz. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 4. *pp.* 481–511, 1939. *In Russian.*—The author develops two methods of determining the correlation and related quantities in solid solutions; the fundamental importance of a method of constructing abstract systems of probabilities is pointed out. An exact solution is given in the case of the linear, and an approximate solution in the case of the three-dimensional problem. Applications of the theory to the thermodynamics of solid solutions are given in the first part of the paper, and to the scattering of X-rays in the second part. D. S.

3701. X-Ray Interference in Cyrstals. G. Molière. *Ann. d. Physik,* 35. 4. *pp.* 297–313, *June,* 1939.—Continuing an earlier paper [see Abstract 3343 (1939)], the author discusses the results of the application of the dynamical theory, developed there, to the reflection, refraction and absorption of X-rays in crystals. New experimental inferences arise from the theory on account of the tensor character and the directional dependence of the coefficients occurring in the fundamental equation. The theory also leads to anisotropy of X-rays, and in the case of Bragg reflection, to a change of the limiting angle in the region of Bragg total reflection, and also of both the directions of polarisation. These effects are of course small but are to be related to the fact that the excited electron states are modified by the lattice structure. G. O. B.

3702. Diffraction of X-Rays from a Crystalline Powder on a Stationary Plane Surface. F. Dupré la Tour. *Comptes Rendus,* 209. *pp.* 51–53, *July* 3, 1939.—A method of taking X-ray powder photographs is described in which the powdered specimen is spread on a plane surface and the diffracted rays received on a photographic plate. Only a few diffraction rings are obtained but in special cases, such as the measurement of polymorphism, dilatation, etc., the method is useful as it is very accurate and the technique is simple. In addition the times of exposure are considerably reduced. [See Abstract 1469 (1939).] J. I.

3703. Total Scattering of X-Rays from Crystals. G. G. Harvey. *Phys. Rev.* 56. *pp.* 242–247, *Aug.* 1, 1939.—A general formula is derived for the total intensity of X-radiation scattered by a general crystal in any direction. In those directions satisfying the Laue equations the formula gives the usual result, while in other directions there is obtained a formula for the total intensity of the diffuse scattering. The derivation is based on classical electromagnetic theory. The form of the result is independent of any assumptions as to spherical symmetry of the scattering atoms or isotropy of thermal vibrations, these factors merely affecting the numerical values of scattering factors and temperature factors and their dependence on angle. Absorption, and the effects of the interaction of incident and scattered radiation are neglected. [See following Abstract.] AUTHOR.

3704. Alleged Discontinuities in Diffuse Scattering of X-Rays from Crystals at Small Angles. G. G. Harvey. *Phys. Rev.* 56. *pp.* 247–249, *Aug.* 1, 1939.—It is pointed out that the positions of discontinuities in the diffuse scattering from crystals, reported by Laval [see Abstract 240 (1936)] all occur at places corresponding to reflections of radiation of one-half, one-third, etc. the wave-length of the main beam. For the case of Al, microphotometer traces of films exposed in such a way as to accentuate the expected effect, are reproduced. They show no discontinuities of the kind reported by Laval, but do show peaks corresponding to the reflection of radiation of half the primary wave-length. It is concluded that the effect reported by Laval most probably does not exist. [See preceding Abstract.] AUTHOR.

3705. Absorption of X-Rays by Metals. A. Kostarev. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 267–279, 1939. *In Russian.*—The author discusses the theory of absorption of X-rays by metals in the approximations of free and nearly free electrons (Sommerfeld and Brillouin respectively), and finds these approximations unsatisfactory. The author also finds Kronig's theory of the fine structure of the absorption inadequate, and concludes that the fine structure is caused by distortion of the electron wave of the removed electron by the neighbouring atoms of the metal lattice. D. S.

3706. Emission Spectra of Radon and its Derivatives. Lines Attributable to Element 85. H. Hulubei and Y. Cauchois. *Comptes Rendus,* 209. *pp.* 39–42, *July* 3, 1939.—The emission spectra (700–1200 X.U.) of Rn and its derivatives were examined by the authors' curved crystal method [see Abstract 220 (1935)]. There were observed within the above limits the whole of the ordinary spectrum of element 83, the L spectrum of 84 but much feebler, and, but feebler still, that of 82. Other lines were also observed, some of which may indicate the presence of 85 among the disintegration products of Rn. C. A. S.

3707. New X-Ray Lines in L-Series Resulting from K Auger Transitions. C. J. Burbank. *Phys. Rev.* 56. *pp.* 142–146, *July* 15, 1939. —Three new X-ray lines in the L series of Ag were found which have wave-lengths of 4·030, 4·016, and 3·805 Å. A fourth and much fainter line was found at 4·023 Å. These lines are due to processes in which an atom, initially ionised in the K shell, undergoes transitions of the type $K \rightarrow LL$ + expelled electron (Auger transition); $LL \rightarrow LM$ + quantum (radiative transition). These lines differ from those previously observed from multiply ionised atoms in that they are more widely separated both from each other and from the diagram lines. An X-ray vacuum spectrograph capable of withstanding a potential of 100 kV across the X-ray tube was used in the observation of these lines. The anode of the X-ray tube was a thin foil of Ag backed with Al. Special precautions were necessary to suppress the continuous background radiation in the region of the lines as the expected intensity of the lines was of the same order of magnitude as the intensity of the diagram line arising from the transition L_{III} to N_{I}. [See following Abstract.] AUTHOR.

3708. Theory of LL-LM X-Ray Lines. R. D. Richtmyer. *Phys. Rev.* 56. *pp.* 146–152, *July* 15, 1939.—The quantum theory is applied to the calculation of the X-ray line structure to be expected from transitions, between doubly-ionised states, of type LL to LM (missing electrons are indicated). Energy levels and wave-lengths are calculated for the Ag atom according to usual ideas of atomic structure. For the calculation of the relative intensities it is assumed that the excitations of the initial (LL) levels arise from internal conversion of K excitation energy. The predicted structure agrees quite satisfactorily with the structure observed by Burbank [see preceding Abstract.]. AUTHOR.

3709. Calculated Wave Functions and Energy Values for X-Ray Terms of Potassium. W. A. Thatcher. *Roy. Soc., Proc.* 172*A*. *pp.* 242–263, *Aug.* 3, 1939.—Self-consistent field calculations, without exchange, have been made for two states of the K atom ionised in an inner group, namely for the configurations $K^{+2}[(1s)^1\ (2s)^2\ (2p)^6\ (3s)^2\ (3p)^6]$, and $K^{+2}\ [(1s)^2\ (2s)^2\ (2p)^5\ (3s)^2\ (3p)^6]$. The results are given in this paper. The perturbation of the wave functions of the outer electron groups on removal of an electron from an inner group is found to be considerable, so that, for example, the $(3s)$ and $(3p)$ wave functions of a K atom ionised in the $(1s)$ group are more like those of a normal Ca atom than like those of a normal K atom. The results may be applied to take this perturbation into account in the theory of the Auger effect or of X-ray dispersion. The application made in the present paper is to the calculation of X-ray ionisation energies. The total energies of these configurations and of the normal state of K^+ have been calculated by Slater's method, and the calculated values of ν/R for the K, L_{II} edges and L_{III} edges and $K\alpha$ doublet obtained and compared with the observed values. The agreement is very good for the K edge and good for the K lines but less so for the L edges. A new method of evaluating one of the quantities, $Y_k(nl, n'l' \mid r)$ required in the evaluation of the energy integrals is given. AUTHOR.

3710. Differences between M_5 and M_4 Absorption Edges in Au (Pure) and Au-Cu Alloy. J. W. McGrath. *Phys. Rev.* 56. *pp.* 137–142, *July* 15, 1939.—The suggestion that the discrepancies between observed and computed energies of the M_4 and M_5 absorption edges arise because transitions occur from the M_4 and M_5 levels to lattice levels, the transitions being governed by some selection rule, was investigated. The M_4 and M_5 edges of Au in the pure state and in a 50 atomic % Cu-Au alloy were photographed in a vacuum spectrometer. The change of lattice constant from 4·06 for Au to 3·86 Å for the alloy, which caused the energies of the lattice levels to change, produced shifts toward higher energies in Au M_5 of 2·5 eV and in Au M_4 of 6·8 eV. This shows that the final levels of these edge transitions are lattice levels. The results give credence to the assumption that, upon assigning to the low lattice levels the values of l which they have in free atoms, there are preferred atomic to low lattice level transitions which are often given by $\Delta l = \pm 1$. Data of other investigators are cited to support the view that the final levels in absorption are lattice levels and that the *l* selection rule is in evidence. AUTHOR.

***3711. High-Load X-Ray Tube. R. Hosemann.** *Zeits. f. techn. Physik,* 20. 7. *pp.* 203–205, 1939.—The principles involved in the construction of X-ray tubes suitable for heavy continuous loadings are discussed. In the tube described the bombarded anode area is increased by moving the whole of the water-cooled anode with a rocking motion of amplitude 10 mm. The movement is produced mechanically by means of a thrust rod working through a vacuum-tight bearing and attached to an external wheel eccentrically driven by a low-geared motor. Up to the present the tube has been used for continuous unattended observations at 10 kV and 150 mA, and higher loadings are possible. J. E. R.

HEAT.

CALORIMETRY.

3712. Rotational Specific Heat and Normal Modes of Vibration of Polyatomic Molecules. Part I. A. Kolossov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 76–91, 1939. *In Russian.*—The author discusses the vibration and rotation of the ozone and benzene molecules using group theory methods. The irreducible representations are obtained with a view to an application to the specific heats of these molecules. D. S.

***3713. Heat Capacity and Heat of Vaporisation of Water in the Range 0° to 100° C. N. S. Osborne, H. F. Stimson and D. C. Ginnings.** *Bureau of Standards, J. of Research,* 23. *pp.* 197–260, *Aug.,* 1939.—The present series of measurements of heat capacity and heat of vaporisation of water in the range 0° to 100° C, have been made to provide greater certainty in the values of the specific heat of water for calorimetric purposes and also to provide greater reliability in the values of enthalpy and the other derived properties for use in steam tables. To ensure the desired accuracy in the specific-heat determinations, complete new calorimetric equipment was designed and built. The same fundamental principles of fluid calorimetry by the electric-heating method were used as in previous measurements extending from 0° to 374° C. In the present case, the limited range of temperature and pressure allowed greater freedom of design to provide for higher accuracy in measurements. Heat leak was accounted for by observation, although it was kept practically nil by insulation and by thermal control of the envelope. Temperature uniformity in the calorimeter was secured by an efficient circulation pump. Temperature uniformity in the envelope was secured by a controllable saturated-steam bath. Temperatures were measured by platinum resistance thermometers supplemented with numerous thermoelements. Heat added was measured electrically. The process of evaporation was closely controlled by manipulation of a sensitive throttle valve. From 256 heat-capacity experiments and 152 vaporisation experiments, as finally reduced and formulated, there was obtained a group of properties of water comprising specific heat, enthalpy of both liquid and vapour, heat of vaporisation, and specific volume of saturated vapour in the range 0° to 100° C. The values of specific heat have been compared with values from several important researches by both the mechanical and the electrical method. This comparison shows a more satisfactory accord of the present results with the results of Rowland, of Laby and Hercus, and of Jaeger and von Steinwehr, than with those of Callendar and Barnes. [See following Abstract.] AUTHORS.

3714. Thermal Properties of Saturated Water and Steam. N. S. Osborne, H. F. Stimson and D. C. Ginnings. *Bureau of Standards, J. of Research*, 23. *pp.* 261–270, *Aug.*, 1939. The completion of new measurements of heat capacity and heat of vaporisation of water in the range 0° to 100° C. [see preceding Abstract] has contributed new data which affect the accepted values of the saturation properties of water and steam in the whole range up to the critical region. With these new data, it is now possible to compile the results of the entire series of measurements which have been carried out in this laboratory into a single table of smoothed values of the properties of saturated water and steam. The compilation presented supersedes the previous tabulations which have accompanied reports of the experimental measurements in this laboratory. AUTHORS.

3715. Specific Heat of NH_4I under Pressure. S. Zlunitzin. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 72–75, 1939. *In Russian.* The specific heat-temperature curves at different pressures were measured for NH_4I, as well as the heat of transition at the transition of the first kind. The specific heat jump at the Curie point was found to increase with increase of pressure. The results are compared with those for the other ammonium halides. D. S.

3716. Specific Heat of Cobalt. G. Duyckaerts. *Physica*, 6. *pp.* 817–822, *Aug.*, 1939. *In French.*—The specific heat of Co has been measured from 2° to 18° K.; the electronic specific heat is found to be $1{\cdot}20 \times 10^{-3}$ T cal./gm. at. deg. AUTHOR.

3717. True Specific Heats of Al and Cu at Temperatures up to Their Melting Points. A. Avramescu. *Zeits. f. techn. Physik*, 20. 7. *pp.* 213–217, 1939.—The true specific heats of Cu and Al at temperatures up to the melting points of the metals have been determined by a new method. Cold-drawn wire specimens were heated by the passage of a current so that they melted in one to two seconds. The heat taken up, the temperatures attained, and hence the thermal capacities of the wires were determined from oscillographic records of the current and potential drop. The evaluation was performed graphically. For Cu the ratio of the specific heat at 1000° C. to that at 0° C. is 1·47, and for Al the ratio of the specific heat at 600° C. to that at 0° C. is 1·26. From 0° C to the melting point, the specific heats of both metals rise linearly with temperature, but the increase is more rapid in the case of Al. The results are compared with those of other experimenters. S. W.

CONDUCTION.

3718. Problem in Heat Conduction. H. S. Carslaw and J. C. Jaeger. *Cambridge Phil. Soc., Proc.* 35. *pp.* 394–404, *July*, 1939.—The problem for which a solution is obtained is that of the conduction of heat in a solid bounded internally by the sphere $r = a$, where from $r = a$ to $r = b$ it is of one material and from $r = b$ to infinity it is of another. Use is made of the Laplace transformation method [see Abstract 4577 (1938)]

to obtain a solution in the form of a line integral. It is then shown that the solution satisfies the differential equation and the boundary conditions.
R. W. P.

See also Abstracts 3515, 3698, 3732.

CONVECTION.

3719. Natural Convection in Liquids. O. A. Saunders. *Roy. Soc., Proc.* 172*A*. *pp*. 55–71, *July* 19, 1939.—A theoretical treatment is given for the natural convection set up near a heated vertical plate, and approximate solutions are derived in terms of dimensionless coefficients. These can therefore be applied to any fluid to give theoretical values for the temperature and velocity and thus for the heat transfer and frictional drag. The mean rate of heat transfer per unit area, H, at a height l is given by $Hl/k\theta = C(Gr.Pr)^{1/4}$, where $C = 1{\cdot}241A$, A being a function of Pr, k the thermal conductivity of the fluid and θ the excess temperature of the plate. For the case of air (Pr = 0·73) three approximate solutions lead to values of 0·403, 0·379 and 0·400 for A, whereas Pohlhausen obtained a value of 0·418 and Saunders' earlier experiments [see Abstract 5194 (1936)] indicate a value of 0·416. In order to test the results for other fluids experiments are described for the determination of the heat losses from vertical steel plates 3 cm. wide and 2·8 and 4·65 cm. high immersed in Hg (for which Pr = 0·03), and for Al plates 30·5 cm. wide and 61 and 30·5 cm. high immersed in water (Pr = 7·0). In Hg the results show reasonably good agreement with the theory, but those for the larger plate in water show considerable departure. The height of this plate is considered sufficient for the laminar fluid flow to give place to turbulent flow, which would cause increased heat transfer. Observations by means of an optical method show that this change in the nature of the fluid flow occurs at a height for which $Gr.Pr = 2 \times 10^9$.
R. W. P.

3720. Convection and Conduction of Heat in Gases. I. Brody and F. Körösy. *J. of Applied Physics*, 10. *pp*. 584–596, *July*, 1939.—The diameter of the " Langmuir film " (b) around warm filaments in gases was at first determined by Langmuir's own method in A, Kr and N_2. The calculated film thickness beside a plane surface is 3·3 mm., 1·4 mm. and 4·3 mm., respectively. The said diameter was then redefined as the distance of thermal interaction between two similar, warm filaments; temperature measurements revealed that this conventional definition corresponds to the 90° C. isothermals. b is a linear function of the temperature; $b_t = b_{1000}[1 + (t - 1000)\cdot 0{,}000255]$ and b_{1000} decreases with increasing molecular weight of the gases. b decreases with increasing gas pressure: $b/b_1 = (p_1/p)^{0\cdot 42}$ and it increases somewhat slower with the diameter of the filament (a) than would correspond to the equation of Langmuir: $2B = b\cdot\ln b/a$. The detailed temperature field around warm filaments was determined under varied conditions. Evidence was gathered that although 90% of the wattage lost can be accounted for by assuming pure conduction, the gas is definitely moving upwards within the film as well as outside of it. [See Abstract 1386 (1912).]
AUTHORS.

See also Abstracts 3533, 3592.

DILATATION.

3721. Shrinkage of Wooden Rods. Schlötzer. *Zeits. f. Instrumentenk.* 59. *pp*. 281–288, *July*, 1939.—The shrinkage of rods of pine, poplar, beech, oak, ash, maple, and alder (dimensions 1 × 1 × 102 cm.), saturated with water and subsequently dried was studied and the results are discussed. The drying process consisted of exposing the rods in a chamber at 39° C. for about 3 days and then cooling slowly to 18° C. over a period of many hours. This treatment was twice repeated until after a drying period of 18 days it could be assumed that the rods were thoroughly dried. In all cases, an initial swelling process was succeeded by a process of shrinkage, the former being much smaller than the latter. The results are interpreted in terms of the author's theory of the elastic after-effect exhibited by spiral-fibrous materials [see Abstract 3503 (1938)]. The contraction, s, in time t, in accordance with the theory is given by $s = K_1(e^{8\sqrt{t}} - 1)\ (e^{8\sqrt{t}} + K_2)$. Values of K_1 and K_2 for all the specimens of wood used are deduced by the method of least squares; the values of K_1 range from $-0{\cdot}468$ to $-1{\cdot}168$; the values of K_2 range from $-0{\cdot}113$ to $-0{\cdot}621$. J. S. G. T.

FUSION AND SOLIDIFICATION.

See Abstracts 3565, 3588, 3700.

TEMPERATURE.

***3722. Liquefaction of Helium. A. van Itterbeek with W. van Dingenen.** *Physica*, 6. *pp.* 728–736, *Aug.*, 1939. *In English.*—The possibilities are studied of the Simon expansion method and from this experimental investigation is constructed an apparatus with great possibilities. The apparatus is described. AUTHORS.

See also Abstracts 3512, 3517, 3518, 3755.

THERMOCHEMISTRY.

3723. Heats of Formation of Maganese Oxides. H. Siemonsen. *Zeits. f. Elektrochem.* 45. *pp.* 637–643, *Aug.*, 1939.—The heats of formation of oxides of Mn are determined calorimetrically, special precautions being taken to use pure starting materials and to exclude side reactions. The following values, which are held to supersede previous determinations, are obtained: MnO, $-93{\cdot}1 \pm 0{\cdot}3$; Mn_3O_4, $-336{\cdot}5 \pm 0{\cdot}2$; Mn_2O_3, $-232{\cdot}7 \pm 0{\cdot}3$; MnO_2, $-125{\cdot}4 \pm 1{\cdot}0$ kg. cal. L. A. W.

3724. Calculation of Li + H Interaction Energy. V. Kiria. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 1–3, 1939. *In Russian.*—The interaction energy of a Li + ion and an H atom is calculated by the method of Heitler and London, and found to be positive, showing that they cannot form a stable system. D. S.

3725. Influence of H.F. Electric Field on Combustion of Gas Mixtures. V. Timkovsky. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 92–95, 1939. *In Russian.*—The results of previous experiments by the author on the influence of very short electric waves on the speed of combustion of an acetylene-air mixture are discussed, and Thomson's hypothesis of the important rôle played by electrons in the flame is confirmed in several respects. D. S.

See also Abstracts 3485, 3527, 3619, 3654, 3655, 3656.

THERMODYNAMICS.

3726. Joule-Thomson Inversion Curves of Recent Equations of State. J. Corner. *Faraday Soc., Trans.* 35. *pp.* 784–791, *July*, 1939.—The Joule-Thomson inversion curves have been worked out for the equation of state recently given by Lennard-Jones and Devonshire [see Abstract 5393 (1937)] and for that of de Boer and Michels [see Abstract 958 (1939)]. The former gives results in reasonable agreement with experiment in the region in which it is valid, *viz.*, at high densities, but not at low. The other equation gives fair agreement where it also is most valid, *viz.*, at low densities. Calculations of critical data show that the Lennard-Jones equation gives better critical temperatures, but not so good values for critical volume and pressure as the equation of de Boer and Michels. AUTHOR.

3727. Phenomenological Thermodynamics of Moving Matter. D. van Dantzig. *Physica*, 6. *pp.* 673–704, *Aug.*, 1939. *In English.*—The paper contains an outline of the phenomenological thermodynamics of moving matter, more particular perfect fluids, with special regard to the invariance under arbitrary transformations of coordinates in space-time, and to the independence of metrical geometry. It is shown that the fundamental equations can be brought into an invariant form which holds in classical as well as relativistic physics. This can be done by means of the temperature vector, the time-component of which is the reciprocal absolute temperature and which is directed along the macroscopic worldlines, and the vector of average momentum and enthalpy per particle. The fundamental invariant, called " thermasy," is the time integral of the absolute temperature. As a special result a relativistic effect (too small to be observable) is found, stating that a temperature gradient in a flowing imperfect fluid (*e.g.*, liquid helium) gives rise to internal friction. AUTHOR.

3728. Sign Problems in Chemical Thermodynamics. E. Lange. *Kolloid Zeits.* 88. *pp.* 89–96, *July*, 1939.—This paper contains a survey of the fundamentals of chemical thermodynamics particularly with respect to the choice of signs when dealing with reversible energy transformations. Among the problems considered are : Transitions from the free standpoint to that adopted in thermodynamics ; sign of an energy transformation in the sense of a principle of positive absolute number ; sign of an energy transformation in the sense of a principle of a centralised standpoint ; consideration of external energy reservoirs ; general observations on the material and historical position and on a complete solution ; and finally a possible solution based on a combination of the Schottky system with suitable sign principles whereby the demands of colloid chemistry are satisfied. H. H. Ho.

See also Abstracts 3509, 3518.

VAPORISATION AND CONDENSATION.

3729. Effect of Alcohols on Partial Vapour Pressure of Acetone. J. E. W. Rhodes. *Chem. Soc., J. pp.* 1135–1137, *July*, 1939.—Acetals are readily produced by the direct action of alcohols on aldehydes, but not on acetone, and the acetals from ketones have to be obtained indirectly. Vapour-pressure measurements on mixtures of acetone with the high-boiling *n*-heptyl, benzyl, and *m*-nitrobenzyl alcohols reveal both a decrease in vapour pressure with time in presence of aqueous HCl, and a considerable decrease in vapour pressure when other known catalysts for the alcoholaldehyde reaction are used. Errera and Sack [see Abstract 2655 (1938)] produced evidence from infra-red spectra for the formation of complexes between alcohols and acetone, but although these complexes might be the result of dipole interaction, the vapour-pressure evidence is in favour of the view that they are acetals. AUTHOR.

See also Abstracts 3714, 3722, 3741.

ACOUSTICS.

3730. Resonant Frequencies of Certain Pipe Combinations. J. D. Trimmer. *Acoustical Soc. of America, J.* 11. *pp.* 129–133, *July,* 1939.—Calculated and measured values of impedance are given for certain combinations of closed and open pipes, with particular attention to the problem of computing resonant frequencies. Several of the combinations have interesting series of resonances, but the relative strength of harmonics in forced vibrations (*e.g.*, as organ pipes) has not been determined experimentally and is hard to predict theoretically. One of the combinations is of particular interest for two reasons: first, although it includes no open pipes, its resonant frequencies are very closely those of a simple open pipe; and second, some of its resonances are much sharper than others, suggesting a method of designing acoustical elements of very sharp resonance. AUTHOR.

3731. Acoustic Transmission Line for Impedance Measurement. W. M. Hall. *Acoustical Soc. of America, J.* 11. *pp.* 140–146, *July,* 1939.—A method and apparatus are described for rapid and accurate measurement of acoustic impedance in terms of the characteristic acoustic impedance of a tube. The measurement consists of the simple determination of the location and relative magnitude of the maximum and minimum sound pressures along the tube. The impedance of the termination of the tube can then be read directly from a slightly modified hyperbolic tangent chart. Two methods are given for measuring the impedance of acoustic elements with cross-sections different from that of the measuring tube. AUTHOR.

3732. Theory of Absorption of Sound in Solids. I. Shaposhnikov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 223–228, 1939. *In Russian.*—An expression is obtained for the absorption coefficient of sound in a solid, to the first order in the coefficients of viscosity and thermal conductivity. The expression is similar to the one valid for a gas. D. S.

3733. Absorption of Supersonic Waves in Solid and Liquid Media. N. Otpushchennikov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 229–232, 1939. *In Russian.*—Preliminary measurements on the absorption of supersonic waves in various media are reported. The absorption coefficients in liquids seem to be much greater than those calculated from Stokes' formula assuming the absorption to be due to internal friction. The absorption in metals is shown to be sensitive to their physical and chemical state. D. S.

3734. Absorption of Supersonic Waves in an Aqueous Hg Emulsion. V. Vladimirsky and M. Galanin. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 233–236, 1939. *In Russian.*—The optical method of measuring intensities of supersonic waves was applied to determine the absorption of waves of frequencies from 1730 to 12225 kc./sec. in an aqueous emulsion of Hg (uniform particle size of $0 \cdot 18\mu$, volume concentration 4×10^{-5}). The results were in good agreement with theory. D. S.

3735. Supersonic Dispersion in Vapours. W. Railston. *Acoustical Soc. of America, J.* 11. *pp.* 107–112, *July,* 1939.—Measurements have been made of the velocity and absorption of supersonics in eleven vapours at several frequencies, using the Pierce method. Two of the vapours—CS_2 and C_6H_6—showed change of velocity with frequency, but in the remaining nine no certain change of velocity could be established. All the vapours absorbed supersonic energy to a greater extent than the Stokes-Kirchhoff theory predicted. AUTHOR.

3736. Loudness of Continuous Spectrum Noise and its Application to Loudness Measurements. F. H. Brittain. *Acoustical Soc. of America, J.* 11. *pp.* 113–117, *July,* 1939.—A sound having a spectrum evenly and continuously distributed over the audio-frequency band is proposed as a reference sound for subjective noise tests in order to permit of subjective determinations being made in any surroundings instead of only in a heavily damped room as at present. Examples are given. The relation between loudness of a single pure tone and a continuous spectrum sound is given, together with some observations on the relative sensitivity of various parts of the cochlea. AUTHOR.

3737. Terminology for Logarithmic Frequency Units. R. W. Young. *Acoustical Soc. of America, J.* 11. *pp.* 134–139, *July,* 1939.—Fletcher [see Abstract 5159 (1934)] has proposed the use of a logarithmic frequency scale such that the *frequency level* equals the number of octaves, tones, or semitones that a given frequency lies above a reference frequency of 16·35 ~, a frequency which is in the neighbourhood of that producing the lowest pitch audible to the average ear. The merits of such a scale are here briefly discussed, and arguments are presented in favour of this choice of reference frequency. Using frequency level as a count of octaves or semitones from the reference C_0, a rational system of subscript notation follows logically for the designation of musical tones without the aid of staff notation. In addition to certain conveniences such as uniformity of characters and simplicity of subscripts (the eight C's of the piano, for example, are represented by C_1 to C_8) this method shows by a glance at the subscript the frequency level of a given tone counted in octaves from the reference $C_0 = 16 \cdot 352$ ~. From middle C_4, frequency 261·63 ~, the interval is four octaves to the reference frequency, so that below C_4 there are roughly four octaves of audible sound. Various subdivisions of the octave are considered in the light of their ease of calculation and significance, and the semitone, including its hundredth part, the cent, is shown to be particularly suitable. Consequently, for general use in which a unit smaller than the octave is necessary it is recommended that frequency level counted in semitones from the reference frequency be employed. AUTHOR.

3738. Measurement of Absorption Coefficients and Application of Acoustical Absorbents. *Acoustical Soc. of America, J.* 11. *pp.* 37–

95; *Disc.*, 96–106, *July*, 1939.—The following set of 9 papers was read before the Tenth Anniversary Meeting of the Acoustical Society of America on 15 May 1939. In planning this symposium three points of view were selected for special emphasis, *viz.*, the testing laboratory, the field and design engineer, and the research laboratory, the whole giving a picture of current progress towards a better understanding of the behaviour of sound in enclosed spaces. The individual contributions were:

"Absorption Coefficient Problem," by **F. V. Hunt** (*pp.* 38–40).—This paper contains an historical resumé of the subject of sound decay, and gives in outline a systematic and logical method of attacking the problem.

"Measurement of Sound Absorption Coefficients from the Viewpoint of the Testing Laboratory," by **P. E. Sabine** (*pp* 41–44)—The conclusions arrived at are: (*a*) The recognition that reverberation values of sound absorption coefficients are conventional values arrived at by standardised test procedure under arbitrarily specified test conditions; (*b*) that test procedure should be standardised, and (*c*) that general agreement should be obtained as to test conditions.

"Correlation of Sound Absorption Coefficients with Field Measurements," by **G. T. Stanton** (*pp.* 45–47).—This author concludes that if the defined conditions required for the reverberation formula to hold are kept in mind, and allowance made for the probable effect on the sound distribution of departures from these ideal conditions, a satisfactory practical agreement between laboratory coefficients and field results may be obtained.

"A Modern Concept of Acoustical Design," by **C. C. Potwin and J. P. Maxfield** (*pp.* 48–55).—This paper deals with room acoustics as a vital element of effective architecture, and the authors recommend that future developments should take into account: (1) Times of reverberation lower than so-called optimum values which are being obtained in many rooms owing to excessive acoustical treatment of surfaces. (2) Double decay rates which are frequently being produced as a result of the massing of acoustical material on single wall or ceiling surfaces or in one end of a room. (3) The present values of so-called optimum times of reverberation can probably be raised, *e.g.*, in cinemas, etc., when acoustical form and the distribution of absorbing material are coordinated in design so that the sound decay is logarithmic for most frequencies and modulated by a maximum number of low intensity pattern changes and a minimum number of high intensity ones. (4) An increase in time of reverberation at the low frequencies appears to be a function of cubic foot volume, form, and the purpose for which the room is to be used. (5) There is a definite relationship, probably with an optimum balance, between the form of a room and the distribution of sound absorbing material within that room. (6) The non-symmetrical arrangement of absorbing material, coordinated with the form of a room, appears to be one of the important elements of efficient acoustical design.

"Some Aspects of the Theory of Room Acoustics," by **P. M. Morse** (*pp.* 56–66).—An exact solution for the decay of sound in a rectangular room is obtained on the assumption that each wall is uniformly covered with absorbing material, which may differ from wall to wall. It is concluded, from recent experimental measurements, that the boundary conditions for the sound field are correctly expressed in terms of the effective normal impedance of the wall material. The sound is analysed into its component normal modes of vibration, and the reverberation times and frequencies of the different normal modes are calculated as functions of the wall impedances and their phase angles. Curves are given for these quantities for a wide range of the parameters involved. The effect of the absorbing material in distorting the sound field is shown, *vis.*, that waves which travel " parallel " to a wall are absorbed by the wall, but are not absorbed as much as are waves striking at more oblique angles ; also that it is sometimes possible to increase the reverberation time for a standing wave by decreasing a wall's effect acoustic resistance, etc.

" Effect of an Absorbing Wall on the Decay of Normal Frequencies," by **N. B. Bhatt** (*pp.* 67–73).—The acoustical damping of individual normal modes of sound in a model rectangular chamber, due to absorbing material on one wall, has been measured experimentally by two different methods. Using a " constant output " source at one of the resonance frequencies the reduction in intensity level due to insertion of the absorbing material was measured—a " steady state " measurement. The reverberation time for each normal mode was also measured—a " transient " measurement. The two sets of data, reduced to the same units, checked fairly well. The combined results were then used to verify some of the predictions of the recent theory of room acoustics. The intercorrelations between these data, and the comparisons with directly measured values of the normal acoustic impedance of the absorbing material verified the theory within experimental error.

" Normal Modes of Vibration in Room Acoustics : Angular Distribution Theory," by **R. H. Bolt** (*pp.* 74–79).—This paper deals mathematically with geometrical and wave-theory room acoustics and in it a modified angular distribution equation is derived. This equation is then applied to the calculation of the average absorption coefficient.

" Analysis of Sound Decay in Rectangular Rooms," by **F. V. Hunt, L. L. Beranek and D. Y. Maa** (*pp.* 80–94).—This is mathematically analysed in terms of the damping of normal modes of aerial vibration, as influenced by the acoustical inpedance of the boundary surfaces. From two to seven decay terms may be required in the complete decay equation under different circumstances, each terms representing a group of the excited modes of vibration having common properties. The results are presented so as to allow determination of the complex wall impedance from consideration of the initial and final slopes of the sound decay curve, and conversely. Experimental decay curves confirm both the detailed predictions of the theory and the sufficiency of the wall impedance as a unique characterisation of wall influence.

" Possible Variation of Sound Absorption Coefficients with Intensity," by **F. J. Willig** (*p.* 95).—Experiments are described which establish that no signficant variation of absorptivity with intensity exists for standard materials. H. H. Ho.

See also Abstracts 3513, 3696, and 2044B. Architectural Acoustics and Electrotechnics. A. Gigli.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstracts

1803B. Inverse Kirchhoff Equations in Electrical Networks. S. Matěna.
1810B. Measurements of Currents, Potentials and Impedances down to 20 cm. Wave-Length. M. J. O. Strutt and K. S. Knol.

CONDUCTION AND DISCHARGE IN GASES.

3739. Calculation of Townsend Ionisation Coefficient. A. Zaitzev. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 4. *pp.* 469–474, 1939. *In Russian.*—The author calculates the values of the ionisation coefficient and the ratio of energy loss of the electrons by ionisation to that by excitation, under two different assumptions as regards the velocity distribution of the electrons. The relation between the electron temperature, and the ratio of electric field to pressure in a positive column of a glow discharge is obtained and compared with experiment. D. S.

3740. Dynamical Properties and Stability of Gas Discharge. C. van Geel. *Physica,* 6. *pp.* 806–816, *Aug.,* 1939. *In German.*—The theory of the gas discharge employing a cold kathode is briefly discussed. It is assumed that n new electrons as well as positive ions are produced by electrons from the kathode; a factor q is defined which has a value of n x the ratio of electronic to ionic discharge current. It is also assumed that q is a function of the p.d. between anode and kathode and of the discharge current. On these assumptions the static and dynamic properties of a discharge are discussed theoretically and mention is also made of the conditions affecting the stability of the discharge. H. J. H. S.

3741. Attachment of H_2O and Noble Gas Molecules to Alkali Ions in Gases. Part I—R. J. Munson and A. M. Tyndall. Part II—R. J. Munson and K. Hoselitz. Part III—R. J. Munson. *Roy. Soc., Proc.* 172*A. pp.* 28–54, *July* 19, 1939.—H_2O clustering on alkali ions in inert gases is studied by measurements of mobility. In He and Ne mobility passes through a minimum with increasing ionic mass, Na having the least and Cs the greatest; this suggests a decrease in the number of clustered molecules with increasing atomic radius, in A, Kr and X an upper limit of 6 can be fixed. From determinations in an ageing field and at different gas pressures it appears that a triple collision is necessary for attachment of the first H_2O but that subsequent growth is rapid. With increasing field, agitation energy of an ion must increase in association with its velocity of drift. Since this is equivalent to higher local temperature one might expect a reduction in the size of the cluster. In fact, mobility is found to approach that of the naked ion as the field increases. The results are correlated with the mobilities of alkali ions in electrolytes by use of Langevin's inverse 5th power law of attraction between ion and inert gas atom. D. R. H.

3742. Various Types of Mercury High-Pressure Discharges. R. Rompe and P. Schulz. *Zeits. f. Physik,* 112. 11–12. *pp.* 691–703, 1939. —The half-value width of the intensity distribution measured transverse to the axis of a high-pressure Hg discharge is shown to be a suitable measure of the width of the contracted discharge column. For pressures above 20 atm. and power greater than 500 W/cm. the width is independent of the power; for the range 2 to 15 atm. and 30 to 80 W/cm. the width is pro-

portional to the square root of the power. Starting from the energy balance of the discharge the Elenbaas-Heller differential equation is deduced and thence, by integration, an equation connecting mean values of discharge parameters; this leads to a simplified model of the h.f. discharge. From the equations are derived properties of some well-defined types of discharge which show satisfactory agreement with experiment.
J. E. K.

3743. Effect of Pressure on Positive Point-to-Plane Discharge in N_2, O_2, CO_2, SO_2, SF_6, CCl_2F_2, A, He, and H_2. H. C. Pollock and F. S. Cooper. *Phys. Rev.* 56. *pp.* 170–175, *July* 15, 1939.—The voltages at which corona first appears in a 3-mm. point-to-plane gap and the breakdown voltage of the gap have been determined with N_2, O_2, CO_2, SO_2, SF_6, CCl_2F_2, A, He, and H_2, and certain mixtures of these gases. This has been done with both positive and negative point polarity and over a pressure range of about 30 atm. The types of corona which were observed are discussed and in particular the marked dependence of the positive point breakdown voltage on pressure in those gases which form negative ions. AUTHORS.

3744. Effects of Irradiation, Humidity and Sphere Material on Sparkover Voltage of 2-cm. Sphere Gap. A. B. Lewis. *J. of Applied Physics,* 10. *pp.* 573–577, *Aug.,* 1939.—Data have been obtained on the sparkover voltage of the 2-cm. sphere gap set at a gap of 4 mm. (10·3-kV peak) showing that: (1) The effect of irradiation is to reduce the sparkover voltage by approximately 2·5% from its unirradiated value and to decrease the scattering of individual observations by a factor of about 4. This irradiation effect is readily saturated by an open, cored-carbon, arc at 50 cm. from the gap. (2) The effect of humidity, which is apparently independent of the sphere material for the five metals used here, is to increase the sparkover voltage by $+ 0{\cdot}1_8\%$ per mm. (of Hg) increase in vapour pressure of the water in the atmosphere. (3) There seems to be no choice between the metals used for spheres (Al, brass, Cr, Ni and steel) so far as repeatability of results is concerned, the probable error of a day's results averaging $\pm 0{\cdot}2_8\%$. This probable error can be largely if not wholly accounted for in terms of known sources of uncertainty. (4) The final sparkover voltages for the various metals, even when corrected to the same humidity, differ from each other by far more than can be accounted for by any definitely recognised source of uncertainty. AUTHOR.

3745. Influence of Kathode on Sparking Potential of Hydrogen. F. L. Jones and J. P. Henderson. *Phil. Mag.* 28. *pp.* 185–191, *Aug.,* 1939.—The sparking potential of H_2 between parallel electrodes, previously de-gassed at a high temperature, was measured throughout a range of gas pressures from 1 to 520 mm. for six different kathodes of the following metals: clean and slightly oxidised Staybrite steel, pure and commercial Al, Ni and Cu. Marked dependence of the sparking potential on the kathode material was found, especially at the minimum values. These were 266·5, 280, 295, and 312·5 V for Al, Ni, Cu, and Fe respectively. The change in sparking potential due to a change of kathode at any given pressure was practically constant throughout the pressure range; consequently, at 520 mm. the fractional change in potential was very small. This change was about 10% at the minimum sparking potential, but less than 0·5% at 520 mm. Hence it was concluded that, at pressures $>$ 1 atm., the material of the kathode would appear to have a negligible effect on the sparking potential of H_2. [See following Abstract.] AUTHORS.

3746. Mechanism of Spark Discharge in Hydrogen. F. L. Jones. *Phil. Mag.* 28. *pp.* 192–202, *Aug.*, 1939.—In this paper the general dependence of the sparking potential of H_2 on the material of the kathode is interpreted on the Townsend theory, and it is found that the experimental results can be readily accounted for. The second Townsend coefficient, γ ($= \beta/\alpha$), is evaluated for four different kathodes, and in all cases γ is found to be a function of Z/p. The variation of γ with Z/p is discussed in relation to the mechanism of the spark discharge, and it is concluded that over a large range of pressures, when $28 < Z/p < 300$, the secondary ionisation is produced mainly by the action of the positive ions, and that the influence of radiation from the gas only predominates at the highest pressures, when $Z/p < 28$. The dependence of sparking potential on kathode material proves that part, at least, of the total secondary ionisation must be attributed to electron emission from the kathode; and the minimum proportions of the total secondary ionisation which must be attributed to electron emission in order to account for the observed dependence of sparking potential on kathode material, were calculated for kathodes of Al, Ni, Cu, and Fe. [See preceding Abstract.] **Addendum and Correction,** *ibid. p.* 337, *Sept.*, 1939. AUTHOR.

3747. Drift of Electrons in Plasma. K. Fataliev, G. Spivak and E. Reichrudel. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 167–175, 1939. *In Russian.*—A method using two probes for determination of the drift of electrons in plasma was used over a wide range of discharge currents. The circuit was arranged to be sensitive to small changes of the probe current. D. S.

3748. Positive Ions and Electron Current Limited by Space Charge. J. Bott. *Ann. d. Physik,* 35. 4. *pp.* 329–332, *June,* 1939.—The variations in electron discharge current, limited by space charge, due to the presence of positive ions, has been investigated theoretically. It is shown that a potential minimum in the region of the kathode is essential for the appearance of space-charge effects, and that the space-charge reactions of the ions suffice to explain the phenomena. Other factors being constant, the space-charge effect increases with the electron emission. The calculations are in satisfactory accord with the experimental work of Kienzle on the action of positive ions on electron current. [See Abstract 5459 (1937).] J. E. R.

3749. Theory of Kathode Fall. Part II. W. Weizel, R. Rompe and M. Schön. *Zeits. f. Physik,* 113. 1–2. *pp.* 87–95, 1939.—The theory is based on the following model: the glow region is a quasi-neutral plasma, almost free of field and fed by a bundle of fast electrons from the kathode space which produce positive ions by collision. From the plasma, positive ions are lost both by diffusion into the kathode space (where they neutralise the major portion of the current on the kathode) and also by recombination. By equating these rates of gain and loss of current carriers, an equation is obtained giving quantitative formulation to the theory and identical in form with that obtained by considering the energy balance of the process. Application to experimental data is discussed. [For Part I see Abstract 2603 (1939).] S. J. G.

3750. Internal Oscillations of L.V. Arcs. W. Funk and R. Seeliger. *Zeits. f. Physik,* 113. 3–4. *pp.* 203–217, 1939.—In l.v. arcs under certain experimental conditions, internal oscillations occur spontaneously. A systematic investigation was made of the ignition potential characteristics of l.v. arcs in the rare gases and also of the distribution, amplitude and frequency of the internal oscillations of such arcs. The results are presented graphically. Study of distance characteristics and the results obtained by the use of probes furnishes an explanation of the production of oscillations. From the measurement point of view the disturbance of the discharge by probes is of interest. A new and simple arrangement for the displacement of probes is described. A. W.

3751. Excess Temperatures in the Glow Discharge. H. Fischer. *Zeits. f. Physik,* 113. 5–6. *pp.* 360–366, 1939.—Measurements were made of the mean excess temperatures in the glow discharge for both plane and hollow kathodes, using H_2, He, Ne, A and air. The kathodes were of pure Al and the pressure range covered was from 0·1 to 8 torr., the kathode energies ranging up to 10 W/cm^2. Previous measurements only dealt with pressures below 0·2 torr and low powers [see Abstract 4625 (1938)]. For H_2 the increase of mean excess temperature with power is almost linear, but for the other gases used the increase is greater at first and more gradual later. The curves for He, Ne and A lie fairly close together and about half way between the curves for air and H_2, the curve for air lying above all the others. A. W.

3752. Passage from Glow to Arc Discharge arising from Short Current Pulses. H. J. Höfert. *Ann. d. Physik,* 35. 6. *pp.* 547–576, *July,* 1939.—When a glow discharge is subjected to short-time current pulses, the discharge, with not too high a kathode temperature, changes to the arc type, if the steepness and the amplitude of the current pulse are sufficiently great. The amount of energy contributed by each pulse to the discharge is not the determining factor in the change to the arc type, which depends more on the pulse current, the probability increasing with increasing pulse current. The duration of the change is of the order of 10^{-8} sec. With high gas pressures metal vapours in very small concentrations, corresponding to a pressure of only a few torr., favour the arc formation. The thermic arc obtained with hot W electrodes differs from the ordinary type in its longer change time, which is of the order of 10^{-4} sec., and in its regular starting and production with high kathode temperature. The effects observed can be explained on the usual assumptions regarding thermal emission. A. W.

3753. Dissociation of Propane, Propylene and Allene by Electron Impact. J. Delfosse and W. Bleakney. *Phys. Rev.* 56. *pp.* 256–260, *Aug.* 1, 1939.—The appearance potentials of all the ions from $C_3H_8^+$ to $C_3H_2^+$ and $C_2H_5^+$ to $C_2H_2^+$ that result from the bombardment of propane, propylene and allene have been measured. Although little is known concerning the energies of the various free radicals formed, it is still possible to specify uniquely most of the reactions which lead to the observed ions. This knowledge in turn allows upper limits to be placed on the ionisation potentials of the free radicals themselves. These limits range from about 9 to 12 V, showing that the ionisation potentials of these radicals do not differ greatly from one another. [See Abstract 1769 (1938).] AUTHORS.

3754. Peculiar Effect in Gases Submitted to U.V. Light. G. Reboul. *Comptes Rendus,* 208. *pp.* 2065–2067, *June* 26, 1939.—When ionisation is produced in a gas by u.v. light instead of by X-rays or radioactive material, after cessation of the light ionisation continues to increase for some 30 min., and then gradually decreases. Filtration through cello-

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phane of the u.v. light shows the effect to be due to the more absorbable radiations. Production of the ionisation is unaffected by filtration of the gas. C. A. S.

See also Abstracts 3602, 3624, 3625, 3626, 3641, 3709, 3797.

CONDUCTION IN SOLIDS AND LIQUIDS.

3755. Resistance of Metals at Very Low Temperatures. S. Vonsovsky. *J. of Exp. and Theor. Physics, U.S.S.R.*, 9. 2. *pp.* 154–156, 1938. *In Russian.*—The author attempts to explain the recently discovered rise of resistance of pure metals at very low temperatures [see Abstract 2136 (1938)] by means of the Bloch one electron model. The theory is based on the assumption that at very low temperatures $\tau > \tau_0$, where τ is the time of relaxation and $\tau_0 = h/eFl$ (l being the mean free path and F the electric field). According to the theory Ohm's law should not be obeyed. D. S.

3756. Contact Resistance of Semiconductors. B. Davydov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 4. *pp.* 451–458, 1939. *In Russian.*—The volume charge appearing at the surface of a semiconductor when there is a contact p.d. between it and the electrode, is formed at the expense of the concentration of free electrons. This causes a change of conductivity of a surface layer whose thickness is determined by diffusion equilibrium. The author calculates the consequent field in the semiconductor and the contact resistances, and shows that for an appropriate sign of the p.d. these resistances appear as a " blocking layer " and cause rectification. The case when there is a potential barrier at the contact is also discussed. D. S.

3757. Temperature Dependence of Electrical Conductivity of Mixed Metal Crystals. S. Ryzhanov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 4–9, 1939. *In Russian.*—An expression is obtained theoretically for the conductivity of mixed metal crystals below the critical temperature of the order-disorder transformation. D. S.

3758. Electrical Conductivity of Thin Metallic Layers. A. Shalnikov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 255–259, 1939. *In Russian.*—A technique is developed for obtaining thin films of low melting point metals by evaporation, which had reproducible properties. The resistance of Cd films was measured as a function of temperature and thickness; for a film of thickness $1{\cdot}4 \times 10^{-6}$ cm. the specific resistance was only twice that of the bulk metal, while the temperature coefficient between 90° K. and 300° K. was 3 times smaller than for the bulk metal. The mechanism of formation of the films is discussed on the basis of the experimental data as regards the variation of resistance with thickness. D. S.

3759. Electrical Conductivity of Alkali Halide Crystals, Coloured by Alkali Vapour. Z. Gyulai. *Zeits. f. Physik*, 113. 1–2. *pp.* 28–35, 1939.—The conductivity of samples of KCl and KBr containing F-centres (produced by exposure to κ vapour) has been studied. These samples do not obey Ohm's law even at low temperatures, the specific conductivity κ increasing with rising voltage, *e.g.*, by 4-fold between 10 and 250 V. κ also greatly decreased as time increases. On decolorising the crystals by exposure to high temperature, Ohm's law again becomes valid but κ is much lower than for control crystals, not coloured, from the same melt. Coloured crystals of KBr, decolourised by exposure to Br_2 vapour at 700°, show a slight increase of κ. The results are explained in terms of the reduction in work of thermal ionisation produced by the electrical field. Reference is made to the analogous effects obtained with moist NaCl particles, due to the adsorbed H_2O. S. J. G.

3760. Properties of Amorphous and Crystalline Quartz in the Electrostatic Field. O. G. v. Altheim. *Ann. d. Physik,* 35. 5. *pp.* 417–444, *July,* 1939.—An investigation of the currents on charging and discharging amorphous and crystalline quartz is described. The measurements include the effect of increasing and reducing the temperature during the determination. The results show that the conduction current in quartz cut parallel to the optical axis is zero, but it is about one million times greater in quartz cut perpendicular to the optical axis than in amorphous quartz. On the other hand the polarisation current is least in amorphous quartz and less in crystalline quartz cut parallel to the optical axis than when cut perpendicular to the latter. In all three varieties an increase of temperature increases the absolute value of the polarisation current and the polarisation formed in a given time. The relative rate of fall of the polarisation currents decreases in parallel cut quartz with increase of temperature but increases in perpendicular cut quartz, and with amorphous quartz is practically unaffected. A. M. T.

See also Abstracts 3496, 3536, 3813, and
1814B. Measurement of High Voltage by Rotary Voltmeter. H. Prinz.

DIELECTRICS AND CAPACITANCE.

3761. Physical Problems of Industrial Insulating Materials. R. Goldschmidt. *Helv. Phys. Acta,* 12. 4. *pp.* 305–312, 1939. *In German.*—Some examples of the properties and methods of investigation appertaining to industrial electrical insulating materials are discussed, with particular reference to resin, wax and paraffin compositions which are soft or liquid at temperatures below 100° C. The well-known curves of dielectric constant and power factor for mixtures of paraffin and colophony, where the temperature loss-curves pass through a maximum are described and briefly explained. These electrical characteristics are compared with physical characteristics such as softening point, specific gravity, etc. Finally the properties of a new moulding material—" Cibanit " of an aniline resin nature is shown to have particularly good properties owing to the number and dispersion of its dipole constants. A. M. T.

3762. Theory of Polarisability. Part I. M. M. Biedermann. *Physica,* 6. *pp.* 717–720, *Aug.,* 1939. *In English.*—The polarisability of a set of electronic systems with perturbation potential $V + FZ$ is discussed in the second and third order of approximation. A rigorous quantum-mechanical proof for the formula of Silberstein is given and an approximate expression is applied to He. [See Abstract 3816 (1938).]
AUTHOR.

***3763. Determination of Dipole Moments in the Vapour Phase. Part I. Improved Apparatus. L. G. Groves. Part II. Moments of Alkylbenzenes and Alkylcyclohexanes. J. W. Baker and L. G. Groves.** *Chem. Soc., J. pp.* 1144–1150, *July,* 1939.—In Part I a heterodyne apparatus is described which employs stabilised matched Hartley oscillators, electronically coupled, the resultant frequencies of which are constant over extended periods to within about 5 parts per million.

The gas cell is vapour-jacketed, and the changes in capacity due to introduction of dielectric gases and vapours are measured by direct parallel replacement on a specially constructed micrometer variable condenser. The beat frequency is observed as a simple Lissajous figure on a kathode-ray oscillograph using the 50-cycle mains as time base. In Part II the dipole moments of toluene, ethyl-, *iso*propyl-, and *tert.*-butyl-benzene, accurately determined in the vapour phase by the method described in Part I, are, respectively, 0·37, 0·58, 0·65, and 0·70 D; that of *p-tert.*-butyltoluene is 0·39 D, in good agreement with the value (0·33) deduced from the moments of toluene and *tert.*-butylbenzene. All the corresponding alkyl*cyclo*hexanes have zero moments in the vapour phase. [See following Abstract.] AUTHORS.

3764. Polar Effects of Alkyl Groups. J. W. Baker. *Chem. Soc., J. pp.* 1150–1155, *July*, 1939.—The values of the dipole moments of toluene, ethyl-, *iso*propyl-, and *tert.*-butyl-benzene [see preceding Abstract] are interpreted on the basis of an inductive electron-release effect $(+I)$ for alkyl groups increasing in the order $\mathrm{Me} < \mathrm{Et} < \mathrm{Pr}^{\beta} < \mathrm{Bu}^{\gamma}$, on which is superimposed a mesomeric electron-release $(+M)$ of the Baker-Nathan type which decreases in the order $\mathrm{Me} > \mathrm{Et} > \mathrm{Pr}^{\beta} < \mathrm{Bu}^{\gamma}$ but is of minor importance in the ground state of the molecule. In the transition state, in reactions which require electron-accession, the Baker-Nathan effect may be greatly enhanced $(+E)$ and so assume the dominating rôle. Using the correlation between the electron-release effects of substituent groups and energy levels contemporaneously being put forward by Hughes, Ingold, Masterman, and MacNulty, it is shown that the results of Baker, Nathan, and Shoppee for the effect of alkyl groups on the prototropic mobility of the methyleneazomethine system, and those of Evans on the acid-catalysed prototropy of the ketones $\mathrm{CH_2R{\cdot}COPh}$ may be adequately explained on the basis of the combined polarisation and polarisability effects of alkyl substituents in the ground and transition states. AUTHOR.

3765. Dipole Moments and Molecular Structure of Methyl and Ethyl Carbonates. G. Thomson. *Chem. Soc., J. pp.* 1118–1123, *July*, 1939.—The dipole moments of methyl and ethyl carbonates have been measured in benzene solution at 25°, and calculation made, with allowance for induction effects, of the moments of possible planar models for these molecules. The value calculated for the configuration of minimum moment for methyl carbonate agrees with the experimental value. Consideration of ethyl carbonate is complicated by the presence in the molecule of four possible axes of free rotation, but it is thought that this, if it is at all possible, is limited to rotation of the terminal methyl groups about the nearer C–O linkage. A possible source of anomaly in Kubo's measurements in the vapour state on methyl carbonate and dimethoxymethane is indicated. It is demonstrated by calculation of the induction effects in ethyl ether that these are sufficient to account for the difference in moment between methyl and ethyl ethers without postulating any change in the oxygen valency angle. AUTHOR.

3766. Dielectric Measurements on Solutions of Long-Chain Molecules. I. Sakurada and S. Lee. *Zeits. f. phys. Chem.* 43. *Abt.B.* 4. *pp.* 245–256, 1939.—Dielectric measurements on solutions of mono- and polychloroprene, mono- and polyvinyl acetate and mono- and polystyrene in benzene, lead to the conclusion that in solutions of these materials, the molecules are not built up into straight, rigid chains but are rather in the form of undulating, loosely knit chains. E. R.

3767. Dielectric Constants of NH_4Cl and NH_4F at their Transition Points. R. Shulvas-Sorokina and V. Evdokimov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 4. *pp.* 475–480, 1939. *In Russian.*—Dielectric constant measurements on NH_4Cl and NH_4F in dependence on temperature showed jumps at − 30·5° C. and − 27° C. respectively. This decides the previously doubtful point as to whether or not the fluoride shows the same type of transition as the chloride in the affrmative. D. S.

3768. Potential Distribution in Solid Dielectrics. A. Venderovich and B. Lapkin. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 46–50, 1939. *In Russian.*—The potential distribution was measured and found linear in fluorite, gypsum, barite, ebonite, micalex, marble and glass. Some properties of glass and marble connected with the formation of insulating layers at high temperatures were studied. D. S.

3769. Maxima of Absorption of E.H.F. Electric Waves in Homogeneous Liquids. P. Guljaev. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 365–368, 1939. *In Russian.*—The author discusses the interpretation of the maxima which occur in curves of energy absorption of e.h.f. electric waves in electrolytes as function of concentration and frequency. D. S.

3770. Capacitance of Wulf String Electrometer. J. Tagger. *Phys. Zeits.* 40. *pp.* 408–409, *June* 1, 1939.—Describes measurements of the capacitance of the Wulf string electrometer and the variation of the capacitance with the deflection. E. R.

***3771. Field in Plate Condenser with Liquid Dielectrics Tested by means of the Electro-Optical Kerr Effect. G. Vafiadis.** *Ann. d. Physik*, 35. 1. *pp.* 23–57, *May*, 1939.—An explanation is given of the application of the electro-optic Kerr effect and the investigation of the course of the field in the plate condenser with liquid dielectric. Especially the optical technique is gone into more fully. An improved Rayleigh compensator is described as well as two newly improved Kerr condensers with new kinds of construction elements. Some systematic sources of error—experimental and partly theoretical—are examined and explained. The edge action in a homogeneous field and the reduced path of light of the Kerr condenser are calculated. The liquids examined were chlorbenzol, ethyl ether, toluol, benzene and hexane. Chlorbenzol was investigated in various degrees of purity from very low (1kV/cm.) up to high fields (∼ 450 kV/cm.) in its stationary condition and in its behaviour with circuit arrangements. Ethyl ether, toluol, benzene, hexane show when pure in the regions of field employed (up to 70 kV/cm.) no noteworthy space-charge, notwithstanding high sensitiveness in the measurement. J. J. S.

3772. Dielectric Measurements. Part II. W. O. Schumann. *Die Physik*, 7. 3. *pp.* 107–117, 1939.—An annotated Bibliography of 120 references to recent work in dielectrics [see Abstract 5211 (1934)]. The references are classified under: Dielectric constant and polarisation; piezoelectric phenomena; dielectric constant of gases having ions and electrons; dielectric loss; anomalous current (d.c.); breakdown of solids; insulating liquids and their breakdown; frictional electricity (" waterfall effect "); Al_2O_3; electrets; and general. W. H. W.

See also Abstracts 3516, 3630, 3725, 3760, and
1793B. Fibre Glass—An Inorganic Insulation. F. W. Atkinson.
1797B. Cellulose as an Insulating Material. G. T. Kohman.

ELECTROCHEMISTRY.

3773. Effect of Rotation on Nature of Deposited Metals. R. Piontelli. *Accad. Lincei, Atti,* 29. *pp.* 322–328, *April* 1, 1939.—The author reports the properties of the films produced by immersing Cu and Zn cylinders in solutions of Ag, Cu, Pb, Cd, Tl salts, while rotated at 5000 r.p.m. (1·83 m./sec. peripheral velocity) at 18° C. In most cases the layer first deposited was dark or grey, spongy and non-adherent, and as the process continues it becomes adherent, and more crystalline. The effect of rotation is a marked lessening of metallic characteristics in the deposit, which becomes adherent, micro-crystalline like kathodic deposits, and apparently non-porous. With Zn-Cu the powdery initial deposit cannot resist centrifugal force but later a pink layer is obtained. The author suggests that relative motion has a similar effect in deposition by chemical or electrolytic means. D. R. H.

3774. Production of Ethane, Quinhydrone, and Potassium Cupric Cyanide by A.C. Electrolysis. J. W. Shipley and M. T. Rogers. *Canad. J. of Research,* 17. *Sect. B. pp.* 167–177, *June,* 1939.—The quantitative production of ethane, quinhydrone, and potassium cupric cyanide by a.c. electrolysis was studied in respect to conditions affecting yield. It was found that a good yield (about 90%) of quinhydrone was obtained by a.c. electrolysis, at low frequency and moderately high current density, of an aqueous solution of hydroquinone. This method of preparation has a distinct advantage in respect to space-time yield over the method of d.c. electrolysis. The current yield of potassium cupric cyanide at low current density (0·3 to 1·0 A/cm^2). using a.c. was in the neighbourhood of 88%. A.c. electrolysis was not found to indicate any particular advantage over d.c. electrolysis, as far as could be ascertained by comparing the ethane efficiency of the two processes. AUTHORS.

3775. Electrolysis of Acid-Ester Salts in Non-Aqueous Solutions, and Mechanism of Crum-Brown–Walker Synthesis. A. Hickling and J. V. Westwood. *Chem. Soc., J. pp.* 1109–1114, *July,* 1939.—A qualitative and quantitative study has been made of the anodic phenomena in the electrolysis of potassium ethyl malonate in ethylene glycol solution. The Crum-Brown–Walker synthesis, *i.e.*, the formation of ethyl succinate, is found to take place with fair efficiency, but is accompanied by marked oxidation of the solvent, mainly to glycollaldehyde. In contrast to the behaviour in aqueous solution, it is found that variable factors, such as temperature, nature of anode material, and presence of foreign kations, have little effect upon the efficiency of ethyl succinate formation. It is concluded that the phenomena can best be explained by supposing that ethyl malonate ions are directly discharged at the anode and the resulting radicals combine to form the acid peroxide; this may then decompose to give ethyl succinate and CO_2, or may alternatively oxidise the solvent, producing glycollaldehyde and generating ethyl hydrogen malonate. A comprehensive scheme for the anodic oxidation of acid-ester salts in both aqueous and non-aqueous solutions is presented. [See Abstract 3828 (1938).] AUTHORS.

3776. Distribution of Charge and Potential in an Electrolyte Bounded by Two Plane Infinite Parallel Plates. A. J. Corkill and L. Rosenhead. *Roy. Soc., Proc.* 172*A. pp.* 410–431, *Aug.* 15, 1939.—In this mathematical paper it is found: (1) That the potential ψ at distance x from a plate is given by $F[k, \sin^{-1} e^{\beta(\psi+\psi_1)}] - F[k, \sin^{-1} e^{\beta(\psi_1-\psi_0)}] = \frac{1}{2}k^{1/2}x$, where ψ increases monotonically from $x = 0$ to $x = /l2$, and then decreases to $x=l$, the system being symmetrical with respect to $x=l/2$. If $al<20$, then $\psi=1/\beta \log e(Ae^{\alpha x}-1)/(Ae^{\alpha x}+1)$. F is the Faraday constant, ν, C, D, R and T have their usual meanings; $\alpha=2\ \nu F\ (2\pi C/DRT)^{\frac{1}{2}}$, $\beta=\nu F/2\ RT$, $k=e^{-2\beta.\psi_1}$ (2) The surface density of charge, σ, on the plates is given by $\sigma=-\sqrt{[(DCRT/\pi)(\cosh\ 2\beta\psi_0-\cosh\ 2\beta\psi_1)]}$. As $l\rightarrow 0$, $\sigma\rightarrow 0$; and as $l\rightarrow\infty$, $\sigma\rightarrow-(2\ DCRT/\pi)^{\frac{1}{2}} \sinh \beta\psi_0$. (3) ψ_0, ψ_1 (the potential at $\chi=l/2$) and l are connected by the equation $\frac{1}{2}k^{-\frac{1}{2}}al=\int_{\alpha}^{\pi/2}d\phi/\Delta$, where $\Delta=\sqrt{(1-k^2\sin^2\phi)}$ and $k^{-\frac{1}{2}}e^{\beta\varphi}=\sin\ \phi$. For any given value of al, ψ, increases with ψ_0 and tends to a finite limit as ψ_0 tends to infinite. As l tends to zero, ψ_1 tends to ψ_0. (4) The consequences of the following assumptions are investigated: (i) when $(\psi_0-\psi_1)$ is independent of l, then a repulsion is produced between the layers, and the distance between consecutive layers diminishes as the number of layers above the point of observation is increased. The range of values of the electrokinetic potential difference, which is identified with $-(\psi_0-\psi_1)$, consistent with experimental results is 5-22 mV. (ii) When ψ_0 or σ is independent of l, attractions are produced which cannot account for the observed phenomena. H. H. Ho.

See also Abstracts 3632 and

1786B. Transfer Resistance. D. K. McCleery.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

3777. Production of Neutrons. C. Weiss and H. Westmeyer. *Phys. Zeits.* 40. *pp.* 461–466, *July* 15, 1939. *From the Reichsanstalt.*—Full experimental details are given of an apparatus for the production of neutrons by the process $D_1^2 + D_1^2 \rightarrow He_2^3 + n_0^1$. The ion source is a l.v. arc with an incandescent kathode, and the neutron intensity is measured and controlled by the induced activity in a Ag cylinder measured with a thin-walled counter. Calculations of the efficiency of the process are given. E. E. W.

3778. Production of Mesotrons. G. Cocconi. *N. Cimento*, 16. *pp.* 78–85, *Feb.*, 1939.—The energy spectrum of the cosmic rays given by Bowen, Millikan and Neher [see Abstract 2854 (1938)] is divided into 8 bands and the theory of Bhabha and Heitler is applied to each band. If the Regener curves at latitudes 50° and 0° are reconstructed, the calculated maxima differ considerably from those observed. Assuming that the energy spectrum above 17×10^9 eV follows a law $Q=KE^{\alpha}$, good agreement is obtained by utilising the results of Nordheim [see Abstract 2422 (1938)]. Assuming that the penetrating part of the cosmic radiation is due to mesotrons, a tentative calculation is made of the probability of production of mesotrons by primary electrons, by consideration of the latitude effect. It is concluded that this probability increases with the energy of the primary electrons, in contrast with the theory of Heitler for very high energies. T. A. C.

3779. Classical Theory of Mesons. H. J. Bhabha. *Roy. Soc., Proc.* 172*A*. *pp.* 384–409, *Aug.* 15, 1939.—The vector equations for the meson field and their associated energy tensor are taken as exact, and the meson-field quantities are taken as commuting classical variables. A self-consistent classical scheme is developed for treating the meson-field and point neutrons (or protons) moving along classical world lines. The scheme takes account of the reaction of the emitted meson field in the motion of the neutron. The mass of the neutron (or proton) which occurs in nuclear phenomena is shown not to be the real mass but less than it by about ten million volts. For high-energy phenomena the real mass counts. Formulæ are given for the scattering of mesons by neutrons which are valid to energies comparable with the mass of the neutron, and supersede the previous formulæ. These show that for the same high energies, longitudinally polarised mesons are scattered much less than transversely polarised mesons, giving them much greater penetrating power. It is shown that classically the reaction of the emitted radiation is not important till energies of ten times the neutron mass and hence that the quantised neutral meson theory which neglects this is valid up to about these energies. It is proved that the rest mass of the meson is not connected with Heisenberg explosions, but that if these exist, they must be due either to the spin interaction g_2 or to the fact that the meson field is electrically charged.

AUTHOR.

3780. Present Dilemma on Values of e, m and h. New Graphical Representation. J. W. M. DuMond. *Phys. Rev.* 56. *pp.* 153–164, *July* 15, 1939.—Experiments determining some function of one or more of the constants *e*, *m*, and *h* are classified into groups, and the three most satisfactory experiments, the directly measured X-ray value of *e*, the many concordant measurements of *e/m*, and the values of *h/e* from the limit of the continuous X-ray spectrum are exhibited on a new type of diagram showing separately the results of all independent reliable determinations and emphasising the discrepancies graphically. The diagram is an isometric projection of a cartesian coordinate system whose axes represent the relative deviations of *e*, *m* and *h* from conventionally assumed values. Planes in this space represent the different experimental determinations of functions of *e*, *m*, and *h*. Numerous possible experimental and theoretical sources of the discrepancy are examined, and modified diagrams are shown for the assumption of various specified fundamental sources of error. It is concluded that some unsuspected theoretical or experimental flaw in the determination of *h/e* by the continuous X-ray spectrum method is the source of the discrepancy, and the need for renewed study of this experiment along with X-ray ionisation and excitation potentials over a wider range of voltages with better spectral resolution is emphasised. N. M. B.

3781. New Method of Determining e/m for Medium High Velocities. J. Aharoni. *Nature*, 144. *pp.* 203–204, *July* 29, 1939.—A new method is suggested for determining 125 (2) *e/m* for electrons of about a million volts energy. It is particularly applicable to electrons and positrons forming the continuous spectrum from radioactive bodies.

AUTHOR.

3782. Elastic Collisions of Mesons with Electrons and Protons. H. S. W. Massey and H. C. Corben. *Cambridge Phil. Soc., Proc.* 35. *pp.* 463–473, *July*, 1939.—The cross-sections for the elastic scattering of mesons by protons and electrons are calculated by analogy with Møller's theory of collisions between electrons, and the results are compared with those of Bhabha for the collisions with protons and electrons of Fermi-Dirac particles with the same mass as the meson. For collisons with electrons, the difference is inappreciable for energies of the mesons less than 100 times its rest energy, but for collisions with protons the difference is important at much lower energies. The ratio of the corresponding cross-sections for scattering by a Coulomb field is found to tend to infinity as the square of the energy of the incident particle, giving a finite cross-section for the scattering of a meson of infinite energy by such a field. It is pointed out that, if an exact solution of this problem is possible for the meson case, the question of the validity of meson theory for high energies would be considerably clarified. AUTHORS.

3783. Electron Diffraction with Low Voltages. J. J. Trillat. *Comptes Rendus,* 209. *pp.* 201–203, *July* 24, 1939.—Electron diffraction is comparatively easy to obtain and to record when monochromatic electrons are accelerated by constant p.d.: between about 10 and 60 kV. But there are various difficulties when lower voltages are employed. The author has obtained good results by making certain modifications in apparatus which he has previously described. Working with 10 mA electronic diagrams both intense and easily distinguishable have been observed by reflection as well as by transmission at 3000 V and perceptible in darkness at lower tensions. The chief difficulty is in recording the diagrams photographically as the emulsions are but little sensitive to the electrons and also these are almost entirely masked by the X-rays produced by the impact of the electrons on the preparation examined. The method has been adopted of photographing the fluorescent screen directly by means of apparatus outside the electronic analyser. Thus electronic diagrams have been recorded down to 3500 V. J. J. S.

3784. Elastic Electron Scattering in Gases. J. H. McMillen. *Rev. Modern Physics,* 11. *pp.* 84–110, *April,* 1939.—This is a report discussing a group of researches, the results of which began to be published around 1927 and which dealt with elastic collisions between electrons and gaseous molecules. In these researches a well-defined beam of electrons was allowed to penetrate a gas-filled chamber and the number of electrons scattered from the beam at various scattering angles was measured. The experimental data have in almost all cases given evidence that the atomic fields are those predicted by the best available method of wave mechanics and they may now be regarded as important experimental evidence supporting the wave theory of electron propagation. The discussion in the report is sectionalised under the headings of scattering of electrons as particles, scattering of electron waves, wave scattering with distortion, the phase shift, amplitude harmonics, wave scattering without distortion, X-ray structure factors and electron scattering, scattering with electron exchange, early measurements, measurement methods, scope of measurements, scattering in the atomic field predominated by the nucleus, experimental evidence supporting Born's theory, Born scattering and atomic electron distribution, distorted waves and diffraction patterns, phase shifts and their determination, comparison with existing atomic field data, diffraction patterns and atomic number, diffraction patterns for heavy atoms, variation of diffraction patterns with colliding electron energies, and electron exchange and polarisation effects. A bibliography of 65 references is included. S. A. S.

3785. Scattering of Electron Beam of 0 to 2 eMV Energy. V. Gei and I. Piskunov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 240–245, 1939. *In Russian.*—The intensity of an electron beam of 1 to 2 eMV from an impulse generator was found to decrease as the inverse cube of the distance from the window of the tube, up to 100 to 200 cm. distance. This result, which is in agreement with Bothe's theory, is characteristic for multiple scattering. An exponential decay of intensity characteristic for a diffuse beam sets in at distances of about 300 to 400 cm., when the electrons have lost a large part of their energy. D. S.

3786. Absorption of Fast Electrons in Li, C, Al, Cu, and Pb. K. Sinelnikov, A. Walther, A. Taranov, A. Ivanoc and V. Gumeniuk. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 127–142, 1939. *In Russian.*—The absorption of electrons of 0·4 to 2·3 emV energy was studied in Li, C, Al, Cu, and Pb, and from the dependence of the range on the energy, the relative electron losses were determined. In the case of the light elements Li and C, the range and $-dE/dx$ both agreed with theory. For the heavy elements there was a discrepancy between the experimental and theoretical values of $-dE/dx$, which if divided by the number of atoms per cm^3. was proportional to Z^2; the authors conclude that the discrepancy is due to multiple scattering. D. S.

3787. Absorption of Slow Neutrons in Cd and Hg. G. Flerov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 143–150, 1939. *In Russian.*—With the help of a special Li counter of which the construction and development are described, the absorption of thermal neutrons corresponding to 290° K. and 500° K. in B, Cd and Hg was investigated. The energy dependence of the absorption cross-section was found to correspond best to a breadth of the resonance energy level in Cd of $\sqrt{2}$ times the energy of the level. In Hg the results require at least two resonance capture levels, and the author finds that Bethe's calculation of the position of the resonance level is incorrect. D. S.

3788. Transfer of Neutrons between Heavy Nuclei in Collisions. E. Lifshitz. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 237–239, 1939. *In Russian.*—The author calculates the probability of transfer of neutrons in a collision between two heavy nuclei. D. S.

3789. Effect Observed in the Passage of Rapid Neutrons through Matter. J. Thibaud and P. Comparat. *J. de Physique et le Radium,* 10. *pp.* 282–290, *June,* 1939.—Confirmation has been obtained of an effect previously observed by Thibaud. The effect consists of a discontinuous variation of the number of disintegrations observed in a vessel filled with N_2 when the thickness of the absorbing material interposed in the path of the neutronic beam is increased regularly. The effect is studied in Pb, Na and paraffin wax. Comparative tests, using paraffin wax as the absorbing material and detecting the collision protons in an ionisation chamber filled with H_2, show that in this case a relatively simple absorption curve is obtained. It appears that the neutrons which have undergone many successive elastic impacts in the thickness of the absorbing material have an appreciable effect. Interpretation of the effect observed in N_2 is more complex, as it is necessary to take into account the variation with thickness of the absorbing material of the mean velocity spectrum of the neutrons and also the resonances corresponding to the nuclear levels of ^{15}N. A. W.

3790. Scattering of "D" Group Neutrons. M. Kimura. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No.* 911. *pp.* 153–164, *July,* 1939.—The back scattering cross-sections of "D" group neutrons for 25 elements were measured using In detectors and absorbers. "D" neutron absorption cross-sections for several elements were estimated from the saturation value of the back scattering intensity. The results are summarised. AUTHOR.

3791. Collision Cross-Sections for D-D Neutrons. W. H. Zinn, S. Seely and V. W. Cohen. *Phys. Rev.* 56. *pp.* 260–265, *Aug.* 1, 1939.—The nuclear collision cross-sections of 22 elements for the neutrons from a D-D source have been measured. The geometrical arrangement of the experiment was such that only small corrections to the measured transmission were necessary. The neutron energy was $2\cdot 88 \pm 0\cdot 04$ eMV. The cross-sections are found to vary irregularly with the atomic weight. The proton cross-section determined for both paraffin and water scatterers is found to be $2\cdot 36 \times 10^{-24}$ cm^2., which is smaller than the value predicted by theory. In addition, the cross-sections of a number of elements for neutrons of $2\cdot 46$ eMV energy have been measured. For some elements the cross-section is found to increase with an increase in neutron energy, for others it decreases. AUTHORS.

3792. Secondary Electron Emission of Mica. M. Kosman, A. Abramov and B. Gurilev. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 176–179, 1939. *In Russian.*—The secondary electron emission from a degassed surface of mica was investigated by measuring the reflection coefficient of electrons from the surface. Very small traces of gas were found to play an important rôle. D. S.

3793. Secondary Electron Emission. Parts IV and V. H. Bruining and J. H. de Boer. *Physica,* 6. *pp.* 823–839, *Aug.,* 1939. *In English.*—In Part IV it is shown that a pure compound of an alkali metal has a high capacity for secondary electron emission. It is pointed out that the electrons fixed to the atoms of the electro-negative element (the electrons in the highest occupied energy band) have the greatest chance of being emitted as secondary electrons. It is proved experimentally that it is impossible that all secondary electrons have their source in metal atoms within or on the surface of the compound. These metal atoms serve only as sources of conduction electrons. In Part V, with the aid of a simple energy scheme (described) it can be understood, that the compounds of metals with a low ionisation energy, consisting of ions with closed electron shells, have a high capacity for secondary electron emission, whereas the compounds of metals with a high ionisation energy have a relatively low secondary emission. [For Part III see Abstract 429 (1939).] AUTHORS.

3794. Electron Optics. E. G. Ramberg and G. A. Morton. *J. of Applied Physics,* 10. *pp.* 465–478, *July,* 1939.—A survey is given of the literature on electron optics. The close analogy between electron and light optics is traced whilst certain important differences are described. It is emphasised that, although in general the theory of geometrical light optics may be applied to electron optics, the practical methods of optical design are different. Methods of tracing electron trajectories through given electrical fields are described as well as the determination of first-order image properties of electron lenses. The quality of the image produced by an electron-optical system is discussed by considering the aberrations of the system. In conclusion, two applications of electron lens systems in television are described. H. J. H. S.

***3795. Intensity and Resolving Power of Electron Microscope. M. v. Ardenne.** *Zeits. f. Physik,* 112. 11–12. *pp.* 744–752, 1939.—The intensity available in the magnetic electron microscope under various conditions of observation is calculated and discussed and the relationships between screen brightness, exposure time and resolving power are derived. The adjustment of the apparatus for least current-bombardment of the object is discussed. Mention is made of the potentialities of ultra-microscopic methods of observation with the electron microscope. J. E. K.

See also Abstracts 3479, 3546, 3748.

ELECTROSTATICS.

3796. Electrostatic Fields. L. Sobrero. *Accad. Lincei, Atti,* 29. *pp.* 190–197, *March* 4, 1939.—It is sometimes convenient to study an electric field by determining at various points, not the potential directly, but the direction of the field. The method is suitable not only for plane problems but also for certain investigations in three dimensions. In plane fields the direction will be indicated at any point P by the anomaly θ, that is by the angle through which must turn (in the direction assumed positive for the rotation) a certain straight line of reference (*e.g.*, the axis x) in order to be made to coincide with the direction of the field at the point P. J. J. S.

***3797. Micafil Generator for 3 MV. A. Imhof.** *Helv. Phys. Acta,* 12. 4. *pp.* 285–288, 1939. *In German.*—Using the process of switching condensers in parallel and in series, a new generator is constructed to yield a potential of 3 MV. Details are given of the experimental assembly ; the apparatus is supplied by Micafil A.G. For use with the generator, **H. Wäffler** describes in the following paper [*ibid., pp.* 288–289] a discharge tube, similar to that used by Baldinger, Huber and Staub [see Abstract 2824 (1938)]. It consists of 20 porcelain stages each taking a potential drop of 150 kV. For evacuation an assembly of oil diffusion pumps is used, working at 300 l./sec. F. C. C.

See also Abstract 3695.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3798. Influence of Foreign Metal Atoms on Hall Effect in Ag. J. Dorfman and P. Zhukova. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 51–58, 1939. *In Russian.*—It was found experimentally that addition of approximately up to 1 atomic % of Zn, Cd, Sn and Sb increase the Hall constant of Ag, while greater concentrations diminish it. The Hall constant is increased by admixture of up to 3 atomic % of Pd or Pt. The effect of lowering the temperature to − 180° C. was studied in pure Ag and Ag-Sn alloys. The authors discuss their results in terms of the electronic structure of Ag, and conclude that the foreign atoms appear as ions in such alloys. D. S.

3799. Hall Effect in Ferromagnetics. V. Rudnitzky. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 262–266, 1939. *In Russian.*—The author discusses the formation of a transverse p.d. due to the interaction of the electrons with the magnetic field of the current. This difference of potential is found to be independent of the external magnetic field and proportional to the intensity of magnetisation, as is the case in the Hall effect in ferromagnetics. D. S.

3800. Change of Resistance of Metals in a Magnetic Field. A. Akhiezer. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 4. *pp.* 426–431, 1939. *In Russian.*—The change of resistance of metals in magnetic fields at very low temperatures is discussed theoretically, assuming the electronic energy is a quadratic function of the momentum. By quantising the energy of an electron in the magnetic field, the author deduces a very marked periodicity in the field dependence of resistance. [See Abstract 1830 (1939).] D. S.

3801. Thermomagnetic and Thermoelastic Phenomena in Ferromagnetics. D. Volkov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 4. *pp.* 444–450, 1939. *In Russian.*—The author describes measurements on the Thomson-Nernst effect (change of thermoelectric force in magnetic field) and the thermoelastic effect (change of thermoelectric force with stress) for weak tensions in iron and nickel wires. The combined effect of a field and a weak tension was also measured. In each case the thermal e.m.f. was measured against Cu. The results were found to agree with Akulov's theory of even-order effetcs. D. S.

3802. Fundamental Relations of Thermomagnetics. A. D. Fokker. *Physica,* 6. *pp.* 791–796, *Aug.,* 1939. *In English.*—Starting from the consideration of a pair of magnetic atoms and of the interaction of a magnetic atom and a coil, the fundamental equation of thermomagnetics is arrived at by realising the work supplied by ponderable forces either in the unordered form of heat, or in a reversible form. The field energy of pairs of atoms, both belonging to the sample under consideration, is added to the ponderable energy to define its energy, E. If the field energy of the magnetic interaction with external agencies is added, the magneto-enthalpy G is obtained. The equations read $Td\mathrm{S} + d\mathrm{W}_{pond} = dE + (\mathrm{J}\cdot d\mathrm{H}_e) = dG - (\mathrm{H}_e\cdot d\mathrm{J})$. AUTHOR.

MAGNETISM AND ELECTROMAGNETISM.

3803. Magnetism. Part IIA. Ferromagnetism. H. Bittel. *Die Physik,* 7. 3. *pp.* 119–139, 1939.—This second report [see Abstract 2758 (1935)] contains the notes on material published during the period 1935–1938 inclusive. The internal field is explained by wave mechanics as due to the mutal action of neighbouring elementary units, and ferromagnetism is therefore dependent on the existence of a space lattice. The report deals with the magnetisation function, single crystals, magnetisation and temperature, magnetic transformation at, and paramagnetism above, the Curie temperature, the technical magnetisation curve, magneto-elastic effects, magnetostriction, anomalies of the elastic properties, magnetic after-effect, magnetisation and thermal and electric magnitudes, magneto-caloric effects, magnetisation and electric resistance, thermomagnetic effects, ferromagnetic materials, homogeneous ferromagnetic alloys, ferromagnetism of alloys of paramagnetic elements, ferromagnetic compounds, heterogeneous ferromagnetic alloys, magnet steels, magnetic anisotropic materials, and Bitter's strips. Numerous references to the original papers are given in the foot-notes. G. E. A.

3804. Long and Short Range Order in Ferromagnetics. L. Stilbans. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 4. *pp.* 432–437, 1939. *In Russian.*—The author discusses the thermodynamic properties of ferromagnetics and shows that the usual methods of calculation which neglect short range order lead to incorrect results for $T > T_c$. Detailed calculations are given to take account both of long and of short range order. D. S.

3805. Nuclei and Spreading of Remagnetisation with Large Barkhausen Discontinuities. H. Haake. *Zeits. f. Physik,* 113. 3–4. *pp.* 218–233, 1939.—In the remagnetisation of a ferromagnetic material the irreversible displacements of the boundary between oppositely magnetised regions play an important part. These phenomena are termed Barkhausen discontinuities ; they are of great importance in determining the coercive force. An oscillographic method was employed to measure the velocity of the remagnetisation wave in stretched permalloy wire (60% Ni) and thence to deduce the critical field-strength. In the remagnetisation process, nuclei of reversed magnetisation are formed, the boundaries of which travel through the material. From the dependence of the starting field-strength on the nucleal thickness the boundary energy was calculated and found to agree with Bloch's formula. The results in general are in agreement with Döring's nucleus theory. A. W.

3806. Magnetic After-Effects at Higher Inductions. J. L. Snoek. *Physica*, 6. *pp.* 797–805, *Aug.*, 1939. *In English.*—A sample of very pure Fe containing a small amount of uniformly distributed C has been prepared which shows pronounced magnetic after-effects. The author's earlier work [see Abstract **4237** (1938)] is now extended by examining the magnetic properties of the new sample in strong fields. The reluctivity is plotted as a function of the temperature for various maximum inductions, measurements being made at a constant time after demagnetisation; from these it is deduced that the relative intensity of the after-effect remains approximately constant up to $B = 6$ but then falls away rapidly and at $B = 100$ is about 10% of its original value at $B = 0$. Some experiments on the reluctivity at low temperatures shows that inductions of the order of 10^5 G must be applied in order to restore fully the high temperature properties, indicating a strong tendency to retain the original state of magnetisation. H. J. H. S.

3807. State of Ni Atom in γ-Phase of Ni-Zn Alloy. J. Dorfman and S. Sidorov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 25–37, 1939. *In Russian.*—Using an improved type of magnetic balance with photoelectric registration, the alloy Ni_5Zn_{21} was found to be strongly diamagnetic analogously to other γ-phase alloys. The authors conclude that the Ni atoms is therefore un-ionised and in an S_0 state, thus bearing out the application of the Hume-Rothery rule to this type of alloy. D. S.

3808. Magnetochemistry of Mixed Crystals. N. Perakis and L. Capatos. *J. de Physique et le Radium*, 10. *pp.* 234–240, *May*, 1939.—A paper completing previous work [see Abstract 2164 (1938)]. In the tetrapyridin persulphate systems, the ions Ag″ and Cu″ have moments of 9·1 and 9·8 Weiss magnetons respectively. For these two ions the theoretical moment is 8·6. When these paramagnetic ions are associated in varied proportions with themselves or with diamagnetic Cd″, their moments vary. In the two cases the mode of variation is almost the same; with the mixed crystal Ag″-Cu″ there may be substituted, within a wide range of concentration, the diamagnetic ion Cd″ for one of the paramagnetic ions without any sensible change in the moment. The variation in the moments of Ag″ and Cu″ caused by dilution is not more than one Weiss magneton, except perhaps for very great dilutions approaching such an extreme that the paramagnetism becomes practically constant. Within a wide interval of concentration the behaviour is as if each of the ions Ag″ and Cu″ had two moments, 9 and 10, and changed from one to the other by dilution, the Ag″ ion to 10 and the Cu″ ion to 9. The coefficients $\chi \times 10^6$, magneton moments and Curie points are plotted against the molecular concentration Ag″ → Cu″. The graphs are not linear. G. E. A.

3809. Paramagnetic Relaxtion in Gadolinium Sulphate. W. J. de Haas and F. K. du Pré. *K. Omnes Lab. Leiden, Comm. No.* 258*a*. *Physica*, 6. *pp.* 705–716, *Aug.*, 1939. *In English.*—The observed differential susceptibility of $Gd_2(SO_4)_3 \cdot 8H_2O$ in an external magnetic field proves to be in accord with theoretical predictions [see Abstract 3855 (1938)]. From the data found the specific heat of the spin system and the relaxation time of the spin-lattice equilibrium have been calculated. AUTHORS.

3810. Magnetic Anisotropy of $CuSeO_4 \cdot 5H_2O$. A. Mookherji and Maung Than Tin. *Zeits. f. Krist.* 101. 5. *pp.* 412–417, 1939. *In English.*—The paper gives a report of measurements on the magnetic anisotropy of the crystal $CuSeO_4 \cdot 5H_2O$. The crystal though triclinic is magnetically nearly uniaxial. The symmetry axis observed is the direction of minimum susceptibility of the crystal. The constants of the magnetic ellipsoid, *i.e.*, the directions of the principal magnetic axes and the susceptibilities, have been determined. AUTHORS.

3811. Variational Principles of the Electromagnetic Field. M. Pastori. *Accad. Lincei, Atti,* 29. *pp.* 48–53, *Jan.–Feb., and pp.* 145–149, *Feb.*, 1939.—Recently Volterra has shown how it is possible to include in a single variational principle the fundamental equations of the electromagnetic field. On forming precisely a suitable function of the six members, components of the electric and magnetic induction, and of their derivatives with respect to time and to the coordinates, such as annul the variation of its integral extended to a region of space-time, the fundamental equations of the electromagnetic field *in vacuo* are obtained. The complementary equations can be deduced in the case considered as consequences of the fundamentals. In these papers on introducing the relativistic conventions the following conclusions are arrived at: As from the conceptual point of view time loses its privileged character to be treated similarly to the other coordinates (spatial), so from the formal point of view the two complementary equations lose their particular character, deviating from all analogy to the other six equations to which the fundamentals give place. Besides, differentials analogous to those that connect the fundamental equations to those that are complementary can be found in other three ways different from the six equations of the electromagnetic field and the two remaining ones. Thus the distinction that seems to hold in Volterra's principle between fundamental and complementary equations appears to lose significance. J. J. S.

3812. Magnetisation Curves of Stretched Ni Wire at Low Temperatures. M. Grabovsky. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 180–188, 1939. *In Russian.*—The magnetisation curves of Ni wire under tensions of from 7 to 17 kg./mm^2. were measured at room, liquid-oxygen and nitrogen temperatures. The low temperature curves always lie below the room-temperature curves and the authors state that they show kinks at fields increasing with the tension. The results are discussed in terms of the various magnetisation processes occurring, and the temperature dependence of the magnetostriction of nickel is deduced. D. S.

3813. Gyromagnetic Effect in Supraconductors. J. Frenkel and V. Rudnitzky. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 260–261, 1939. *In Russian.*—From the experiment of Kikoin and Goobar [see Abstract 3860 (1938)], the authors conclude that the large diamagnetism of supraconductors is due to motion of electrons in orbits in the crystal lattice as if the electrons were " free " in the sense of having effective mass and charge equal to the ordinary free values. D. S.

3814. Magnetic Texture and Magnetoelastic Hysteresis. M. Dekhtjar. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 4. *pp.* 438–443,

1939. *In Russian.*—It is shown that magnetic texture of a certain kind increases the initial susceptibility of undeformed iron crystals, and it is deduced that in weak fields only the process of longitudinal inversion takes place. The magnetoelastic hysteresis was also investigated. D. S.

See also Abstract

1828B. Magnetometer with Astatic System in Uniform Field. H. Neumann.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3815. Electrodynamic Field in Living Organisms. H. S. Burr and F. S. C. Northrop. *Nat. Acad. Sci., Proc.* 25. *pp.* 284–288, *June*, 1939.—The paper consists chiefly of a summary of previously published observations on the electrical properties of living organisms, carried out with the authors' "vacuum tube microvoltmeter." The general thesis put forward is that a living organism of any kind is associated with an electrodynamic field which is modified by changes, pathological or otherwise, in any part of the organism. J. E. R.

3816. Action Currents and Theory of Nerve Fibre Excitation. G. Déchène and J. A. Reboul. *Comptes Rendus*, 209. *pp.* 69–72, *July* 3, 1939.—The hypothesis that the origin of the nerve-fibre wave is to be found in modifications of the contact potential between the axis and outer sheath of the fibre is examined theoretically. Starting from first principles with a concentric cylinder model it is possible to obtain a relationship showing this variation of contact potential. The results indicate a smooth variation of Δe, and give no support to the more generally accepted ideas of discontinuous changes. The suggestion is put forward that the excitation and propagation of the wave depends rather on a variation in the capacity of the elementary nerve system. J. E. R.

3817. Efficiency Curves in Quantitative Radiobiology. W. H. Love. *Radiology*, 32. *pp.* 708–712, *June*, 1939.—If the characteristics of the tissue and the physical conditions of the irradiation are known, it is possible to plot two related sets of curves, the one showing the correlation between the quantitative biological effect M and the variable irradiation time t for constant radiation doses $q_A, q_B, q_C, \ldots$ and the other showing the correlation between M and the variable radiation intensity α for the same radiation doses. Employing the results obtained in an earlier paper [see Abstract 1380 (1937)] graphs and figures are constructed for the most general case of any irradiated tissue. It is shown that the critical intensity, *i.e.*, that intensity with which is associated maximum biological effect for a given dose, is in general a function of the radiation dose, and that it may even be independent of the dose. For any fixed partial dose, the mortality sustained by the cells in the radiosensitive condition at the commencement of the irradiation, becomes small compared with that sustained by the cells which are subsequently irradiated. T. A. C.

3818. Short-Distance L.V. X-Ray Therapy. P. A. Flood and D. W. Smithers. *Brit. J. of Radiology*, 12. *pp.* 462–485, *Aug.*, 1939.—The origins of short-distance low-voltage X-ray therapy are referred to and its scope and advantages discussed. The systems of dosage employed by other workers are described. The system of dosage and dose distribution that was adopted by the author is set out, and the technique employed is illustrated by reference to actual cases treated. The results of treatment are referred to briefly. Stress is laid upon the desirability of achieving as even a distribution of the radiation throughout the tumour as possible by carefully planned treatment or by the use of special applicators. It is pointed out that in this method the maximum and minimum tumour dose is determined as accurately as possible in every case. The method is compared with that known as " X-ray cauterisation " and with methods where the dose is based solely on immediate tumour response. It is thought that the method advocated avoids both underdosage of the deeper parts of the tumour, therefore minimising the risk of subsequent recurrence, and overdosage of the more superficial parts of the tumour and surrounding tissue, therefore reducing the risk of late necrosis and improving the cosmetic results. This method also enables the effects of treatment in relation to the tumour dose received to be judged. AUTHORS.

3819. Biological Effects of γ-Irradiation. S. Russ and G. M. Scott. *Brit. J. of Radiology*, 12. *pp.* 440–441, *July*, 1939.—Describes a continuation of previous work [see Abstract 4728 (1937)] on the irradiation of rats with γ-rays with the object of ascertaining tolerance doses. The rats were exposed for five days a week over a period of 168 days and given a total dose of 1480 röntgens. 24 young rats were used in the tests, and a batch of 27 similar animals kept as controls. The death rate among the irradiated rats (45·8%) was greater than among the controls (14·8%), while the surviving irradiated rats aged more quickly and suffered much damage as regards breeding powers. G. E. B.

***3820. Radium Implant Reconstructor. H. M. Parker and W. J. Meredith.** *Brit. J. of Radiology*, 12. *pp.* 499–503, *Aug.*, 1939.—Two devices for the reconstruction of the spatial distribution of a number of radium needles implanted into tissue are described, and the methods of their manipulation outlined. The question of optimum conditions is discussed, and the possible use of the apparatus outside the field for which it was designed is stressed.

3821. Mitogenetic Radiation. H. Barth and O. Glasser. *Radiology*, 33. *pp.* 25–33, *July*, 1939.—Although similar Geiger-Müller counter tubes have been used at the authors' laboratory at Cleveland to those in use at Gurwitsch's laboratory at Leningrad, no positive results on mitogenetic radiation have been obtained beyond the experimental error. Some 33 new counter tubes have been built, using Cu or CuI as the photoelectric surface, enclosed in a quartz tube filled with H_2 at a pressure of 15–150 mm. Radiation sources were formed by introducing 2–3 drops a sec. of 0·1 *N* solutions of $K_2Cr_2O_7$ and $FeSO_4$ into a reacting vessel. This oxidation reaction gives an easily reproducible source of u.v. which serves as a characteristic test of the sensitivity of counter tubes to mitogenetic radiation. In these tests, it was found that many of the materials in the laboratory showed radioactive contamination, which was ascribed to a radon apparatus containing 1 gm. of Ra in solution, in the basement of the building. A survey of all the experiments has convinced the authors of the futility of carrying out successfully any mitogenetic work in a building which is infected with radioactive decay products and it is proposed to continue the experiments in a building free of any such contamination. T. A. C.

See also Abstracts 3711, 3754, and

1891B. Modern Technique of H.T. X-Ray and Neutron Tubes. M. Matricon.

OSCILLATIONS AND WAVES.

3822. Natural Electromagnetic Oscillations of a Spherical Cavity. M. Jouguet. *Comptes Rendus*, 209. *pp.* 25–27, *July* 3, *and pp.*

203–204, *July* 24, 1939.—Using Maxwell's equations in polar coordinates, the author examines the conditions of electromagnetic oscillations in a spherical cavity in a perfect conductor. The conditions considered are those with a symmetry of revolution, and the characteristics are determined of the magnetic and electrical oscillations. The author also presents a method for the determination of the conditions of natural electromagnetic oscillation in a cavity limited by any surface of revolution in a perfectly conducting body. The method leads to results obtained above for the sphere. It is applicable to the cavity within any surface of revolution and in the case of ellipsoids the solutions are expressed by Lamé products. R. E. N.

3823. Midday Decrease of Ionisation in the Higher Ionosphere. I. Ranzi. *Ricerca Scientifica*, 7. *pp.* 540–545, *June*, 1939.—Evidence is produced which is held to be contrary to the hypothesis of Appleton and Naismith that the decrease in ionisation which occurs at noon in the higher ionosphere is produced by temperature change due to the absorption of solar radiation. It is suggested that the phenomenon is to be attributed to the diminution in electron density consequent on the capture of electrons by atoms formed by the photodisintegration of gas molecules. F. C. C.

3824. Ionosphere and Short Wave Fade-Outs. R. Jouaust. *J. de Physique et le Radium*, 10. *pp.* 251–259, *June*, 1939.—After a general summary of our present knowledge of the ionosphere, a brief description is given of the results of observations of the sudden disappearance of signals on short waves. The explanation, that the ionisation below the E-layer is suddenly augmented, is discussed, and the various hypotheses put forward to account for the phenomena are discussed shortly. J. P. A.

3825. Reinforcement on Long Waves at Time of Short Wave Fade-Outs. Observation by Recording of Atmospherics. R. Bureau. *J. de Physique et le Radium*, 10. *pp.* 260–270, *June*, 1939.—Atmospheric parasites constitute a natural system of radio emissions over a wide range of frequencies, and can be used for ionospheric investigations. Present knowledge of the origins of atmospherics and of their diurnal variations is summarised. A sudden decrease in the number of atmospherics on wave-lengths between 7500 and 16000 m. is observed at sunrise and sunset. At the time of a fade-out on short waves, the record of long wave atmospherics shows an equally sudden rise. Provided that the strongly ionised layer below the E-region, postulated to explain the fade-out, can behave as a reflector to long waves, the results (which are illustrated by a number of records) can be accounted for. J. P. A.

3826. Fading of Short Waves and Terrestrial Magnetism. L. Eblé. *J. de Physique et le Radium*, 10. *pp.* 271–273, *June*, 1939.—The connections between solar activity and terrestrial magnetic perturbations are both numerous and complex. In particular it is frequently found that the fading or vanishing of short radio waves coincides with small variations, of sudden incidence but of relatively short duration, in the values of the magnetic elements. Both these effects appear to be intimately connected with u.v. emissions from the chromosphere. A. W.

3827. Solar Eruptions and Ionospheric Perturbations. L. d'Azambuja. *J. de Physique et le Radium*, 10. *pp.* 275–281, *June*, 1939.—After defining what is meant by the term "chromospheric eruption," the author indicates the reasons which led to the creation of an international association for observation of such eruptions by means of the spectrohelioscope. He also shows that at the present time the association includes 23 observatories and that, under the most favourable conditions, observation of the sun is nearly continuous throughout the 24 hours of each day. Results obtained by this organisation are presented and details are given regarding the frequency of solar chromosphere eruptions and the regions of the disc where they are more frequently produced. Discussion of the relations between these eruptions and certain terrestrial phenomena shows that they are closely connected with the fading of short radio waves and with the reinforcement of the atmospherics observed on long wavelengths. A. W.

3828. Radio Fade-Outs and Solar Eruptions. R. V. Giovanelli and A. J. Higgs. *Terr. Mag.* 44. *pp.* 181–187, *June*, 1939.—A summary of simultaneous observations of solar eruptions and radio fade-outs observed at the Commonwealth Solar Observatory, Canberra, between June, 1937, and Dec., 1938, is given. From a close examination it appears that (1) a fade-out will not accompany an eruption unless the intensity of the eruption exceeds 105% of the continuous spectrum, and unless the product of the intensity and area exceeds a certain limiting value, (2) eruptive prominences due to eruptions behind the limb do not generally cause fade-outs, and (3) the chance of a fade-out accompanying an eruption varies from a maximum with the sun overhead to zero with solar altitude 15°. From the variation it is deduced that the mean absorption coefficient above the E-layer, for the radiation causing fade-outs, is about $0 \cdot 3$ cm^{-1}. J. P. A.

3829. Partial Reflection of Radio Waves in a Stratified Medium. K. Rawer. *Ann. d. Physik*, 35. 5. *pp.* 385–416, *July*, 1939.—A repetition, rather more detailed, and using a somewhat different mathematical method, of work previously described [see Abstract 3056 (1939)]. J. P. A.

See also Abstracts 3750 and

2015B. Polarisation of Radio Waves Reflected from Layers Formed during Magnetic Storms and Auroræ. L. Harang and W. Stoffregen.

2016B. Propagation of Electromagnetic Waves in Cylindrical Guides. A. G. Clavier and V. Altovsky.

PHOTOELECTRICITY.

3830. Selenium Photo-Cells. Part III. Behaviour in H.F. Circuits. F. Goos. *Zeits. f. Physik*, 113. 5–6. *pp.* 334–349, 1939.—Becker has previously dealt with the behaviour of Se cells with applied d.c. potential [see Abstract 3474 (1939)]. The present work is concerned with their behaviour in h.f. fields. The method employed makes use of a buzzer. The behaviour in h.f. fields is explained by consideration of the equivalent electrical circuit. The almost momentary photo-effect of the insulating layer with the spectral maximum in the yellow-green is not found at high frequencies, when the phenomena in the base material, in this case Se, come more into play. The slow variation due to illumination has its maximum in the red-infra-red. Experimental data are given regarding variations with time, spectral distribution, light intensity and temperature. Analogies are drawn with the behaviour of ZnS phosphors. The effects are explained by resistance and capacity variations of the semiconducting base material and the properties of a particular cell can be derived from its circuit equivalent. The behaviour in a h.f. circuit can be explained from the vector diagram. It is possible to determine the unknown parallel capacity and hence to obtain a value for the dielectric constant of the semiconductor. A. W.

***3831. Photoemissive Cell Specially Designed for High Precision Measurements. G. A. Boutry and P. Gillod.** *Phil. Mag.* 28. *pp.* 163–184, *Aug.*, 1939.—As the electrical response of commercial photoelectric cells is not proportional to the amount of incident light, a successful attempt is made to design a cell with a porportional response. In most cells there are several factors causing non-proportionality; the potential necessary for saturation produces ionisation by collision in the residual gas; a space charge owing to the relative smallness of the anode; surface charges on the glass envelope. The paper describes a cell consisting of a circular disc as kathode with a concentric annular guard ring both coated with Cs, and an anode made of a number of thin parallel wires placed parallel to and 2 mm. from the kathode. The whole was enclosed in a large glass envelope with the seals of the leads for the kathode, guard ring and anode such that good insulation obtained. Several such cells were constructed all of which required less than 4 volt between kathode and anode for saturation. With such an arrangement, with the guard ring at the same potential as either the kathode or anode, and with either the kathode alone or both kathode and guard ring illuminated, no deviation from proportionality was detected over a considerable range. A null method for measuring the current was used. A more detailed examination of the behaviour of the cells revealed that slight space charge effect existed, and in an Appendix there is given a theoretical derivation of the potential distribution between parallel electrodes in the case when the initial velocity of the electrons is not negligible. A modified design of a cell with a linear response is briefly described. W. E. D.

3832. Photoelectric Effect of Sensitised Active Kathodes. S. Ryzhanov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 38–45, 1939. *In Russian.*—A theory of the photoelectric effect of sensitised active kathodes is given, based on the view of de Boer and Frenkel that the mechanism of photo-ionisation is that of a photo-effect from the adsorbed layers of the photo-active metal. D. S.

3833. Process of Formation of the Blocking-Layer Photo-Effect. G. Dubovov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 284–292, 1939. *In Russian.*—The author describes experiments on the properties of a selenium sulphide blocking-layer photo-element and finds its characteristics to be similar to those of copper oxide and selenium elements. The mechanism of the effect is discussed and it is concluded that the blocking layer consists of crystalline sulphur, and also that the fatigue of the effect is of thermal origin. D. S.

3834. Photovoltaic Effect in Silver Halides. A. Molchanov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 2. *pp.* 157–162, 1939. *In Russian.*—The e.m.f. arising from asymmetric illumination of polycrystalline layers of AgI, AgBr, AgCl was investigated as regards the spectral distribution of the effect, and its dependence on the intensity and time of illumination and on the dampness and arrangement of the electrodes. D. S.

3835. Electron Shift in the Internal Photo-Effect. P. Tartakovsky. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 280–283, 1939. *In Russian.*—The internal photo-effect in X-ray irradiated and coloured rock-salt was investigated by the optical probe method; in particular the spectral distribution of the depolarisation current was measured. The question of the mechanism of recombination of the electrons at the end of their paths is discussed. D. S.

3836. Internal Photo-Effect Due to U.V. Rays in Deformed Crystals. N. Gasting and V. Poddubny. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 4. *pp.* 467–468, 1939. *In Russian.*—Experiments are described on the effect of u.v. radiation on the direct and reverse photocurrent in crystals of NaCl deformed by pressure. The results are interpreted in terms of the energy levels to which the electrons are bound. D. S.

THERMIONICS.

3837. Contact Heterogeneity on Surface of Thoriated Tungsten. N. Morgulis and V. Dyatlovitzkaya. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 3. *pp.* 293–301, 1939. *In Russian.*—Using the method of thermal ionisation of Na atoms the contact heterogeneity caused by a film of Th on a W surface was investigated. From their results the authors conclude that Th is adsorbed only in certain spots of the surface reducing the work function there from the clean W value (4·5 eV) to 2·9 eV. At other places the Th is practically not adsorbed at all, leaving the work function at 4·5 eV. The results are not in agreement with the work of Becker and Nottingham who used an electron emission method. D. S.

THERMOELECTRICITY.

3838. Thermoelectric Power of the Superlattice Alloy $AuCu_3$. Y. Takagi and T. Satô. *Phys. Math. Soc., Japan, Proc.* 50. *pp.* 251–258, *May,* 1939. *In English.*—It has been shown theoretically by Muto that, considering the thermoelectric properties of some non-superlattice alloys whose components are noble metals, the behaviour of the thermoelectric power *v.* composition curves is chiefly determined by the behaviour of the residual resistance *v.* composition curves of these alloys. The flat minimum of Rudolfi's experimental curve of the thermoelectric power of the Au-Cu system has been explained on considering that the residual resistance ρ_0 has its maximum at about the middle of the composition diagram and is expressed approximately by $\rho_0 = Qx(1-x)$ where x represents the atomic concentration of one of the constituent metals. The residual resistance of a superlattice alloy changes remarkably with the order-disorder transformation and in the present paper an investigation is undertaken to find how the thermoelectric power changes when the alloy goes through this transformation. The change was found to be very conspicuous and it resembles very much the change of resistivity in the course of the transformation. Theoretical considerations are given using the nearly free electron models. J. J. S.

3839. Calculation of Peltier Effect. J. A. Chalmers. *Cambridge Phil. Soc., Proc.* 35. *pp.* 521–522, *July,* 1939.—Fowler's thermodynamical method for calculating the Peltier and Thomson coefficients by using a virtual current method has been criticised by Stern on two grounds. One is that the method charges the metals. In the present paper this objection is met by considering that the density of electrons remains constant and not their volume as Fowler had assumed. This results in a value for the Peltier coefficient three times greater than that obtained by Fowler, but still only half that obtained by recent transport methods. It is suggested that this latter discrepancy gives point to Stern's second criticism. W. E. D.

See also Abstract 3720.